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II.

CLINICAL, ANATOMICAL, AND BRIEF HISTOLOGICAL DESCRIPTION OF TEN CASES OF FEEBLE-MINDEDNESS.

WITH EIGHTY-FOUR PLATES (WAVERLEY RESEARCH SERIES, CASES I-X).

E. E. SOUTHARD AND ANNIE E. TAFT.

We proceed to a condensed description of the findings in Cases I-X of the Waverley Research Series. For convenience we offer the following table, showing a number of facts about each case, chiefly of a catalogue nature:

Research Series number	Clini- cal Source number	Local Autopsy number	Harvard Series number	Photo- graph number	Sex	Actual Age	Assigned Mental Age	Height last taken	Brain Weight, grams	Brief designation
I	W. 2268	Taylor, 65	14.5	28	M	5	1—app.	82	400?	Microcephaly
II	W. 1437	Taylor, 21	14.6	26	M	20.5	1—app.	subn.	620	"
III	D. 14550	D. 1279	12.20	24	M	45	7 app.	126	610	"
IV	D. 16282	D. 1517	12.21	23	F	62	12±app.	143	1340	Moron or subnormal
V	D. 14779	D. 1413	13.13	1413	M	16	12±app.	168	1435	Subnormal, dementia praecox
VI	W. 1453	Canavan, 3	13.47	75	M	26	2 Binet	158	1130	Idiot
VII	W. 1574, 1618	Canavan, 8	14.13	78	F°	25	5(2—)3 Binet	146	1270	Imbecile
VIII		Magrath, 3917	12.22	1	M	36	12±app.	179	1340	Murderer
IX	W. 808 Bur- bank 9760	S.B.I. 14.22	14.69	14.69	M	39	7 Binet	178	1620	Imbecile
X	W. 971	S.B.I. 14.69	15.2	15.2	M	37	2.4 Binet	144	1450	Imbecile

W. = Waverley (Massachusetts School for Feeble-minded). Burbank = Burbank Hospital, Fitchburg. Canavan = private autopsy series, M. M. Canavan. D. = Danvers State Hospital. Magrath = Medical Examiner's series, G. B. Magrath. S.B.I. = series since establishment of Massachusetts State Board of Insanity, Pathological Service, July 1, 1914. Taylor = private autopsy series, E. W. Taylor.

The items of our description call for little comment. They are in general:

- a. Clinical Findings
- b. Autopsy Findings
- c. Special Description of Brain
- d. Partial Microscopic Description
- e. Anatomical and Histological Summary.

As to *a. Clinical Findings*: These have been arranged so far as possible to follow a scheme employed at the Massachusetts School for the Feeble-minded and originated by Dr. W. E. Fernald. The headings are ten in number, as follows:

1. Physical Examination.
2. Family History.
3. Personal and Developmental History.
4. History of School Progress.
5. School Examinations.
6. Practical Knowledge.
7. Economic Efficiency.
8. Social History and Reactions.
9. Moral Reactions.
10. Psychological Tests.

Following the items thus arranged are notes, usually brief, concerning the institutional history, if any, of the patient.

As to *b. Autopsy Findings*: These are limited to the gross anatomical findings of the examiner as made on the autopsy table. Their results are more systematically given in table form in Article III.

As to *c. Special Description of Brain*: The data are founded upon examination, as a rule, subsequent to the autopsy and to the preservation of the brain, which has been in all cases in 10% formaldehyde solution, in many cases for relatively long periods, which are obvious from the dates included in the descriptions. As a rule, the special brain description has had the advantage of comparison of the brain specimen itself with the photographs, systematically taken, of the brain before and after stripping the pia mater. These descriptions are largely the product of Dr. Taft, who has personally stripped each brain of the pia mater, preserving the pia mater in certain cases where there was question of important lesion therein. The nomenclature is, as a rule, self-explanatory and follows largely the nomenclature of Quain's *Anatomy*.

As to *d. Partial Microscopic Examination*: It must be insisted that this is really but partial and has no pretensions to the completeness which the resources of a modern laboratory will eventually command. Nevertheless, we have resorted in each instance to total brain sections stained by the Weigert myelin sheath method in our estimates of the fibre content of the brain. The resulting estimate is, as a rule, entirely qualitative. But it may be questioned whether it is possible at this time to make more than a qualitative estimate of fibre contents. The total brain sections stained by the Weigert method have been of value in the estimates of the depth of the corpus callosum, as well as for the purpose of discovering special periods of degeneration or faulty development of fibre systems.

We have, also, employed staining methods for the study of cortical architecture,

employing as a rule cresyl-violet in place of thionin and methylen blue. This sharp nuclear stain has permitted us in most cases to make a profitable study of the cortical lamination, as well as to bring out the exudate about vessels where exudate is present. As will be emphasized in Article III, the existence of exudate in more cases than had been at first suspected is probably of importance from the genetic standpoint, since syphilis or some kindred chronic inflammatory condition may be suspected in cases with such exudate. Again, we have been able to observe rod cells in certain cases, which cells again tend to indicate a more progressive condition than has been considered typical in cases of feeble-mindedness. In suitable cases, we intend to make special topographical studies of cortical laminations. This we have in hand in chosen instances, and the resulting descriptions are intended to appear in later articles in this series. For the present, as will be evident from Article III, we have limited our microscopy to the question of exudate, rod cells, and the like, on the one hand, and to qualitative estimates of cortex lamination, fibre content, on the other.

As to *e. Anatomical and Histological Summary*: We have attempted to bring out the main structural points in each case, with, however, little or no attention to the total genetic picture presented by the case. This total genetic picture is reserved for Article III.

Further light upon the anatomical situation presented by each brain is offered in the description of the plates. The most inclusive view of each case from all available aspects: clinical, anatomical, histological, and genetic, together with points especially mentioned in the description of the plates, is given in Article III.

SYNOPSIS OF FINDINGS OF CASE I.

a) Clinical.

1. Physical Examination.—P. Cap. was born June 19, 1897, and upon admission, at five years of age, was 32 inches tall and weighed 16 pounds. A photograph shows typical microcephaly, with a head roughly diamond-shaped when viewed from the side, with large ears; spinal caries of the dorsal region, with anterolateral curvature; thighs sharply flexed on abdomen, and legs flexed on thighs; arms slightly flexed and in position of contracture at elbows; strabismus. The eyes are described as "rather intelligent looking" despite the patient's inability to understand things said. Patient would turn head when spoken to, and follow persons or bright objects with his eyes. Spastic crural paraplegia; slight ability to move hands and arms, and ability to grasp small objects with the hands. Although unable to walk, the patient was able to push himself along the floor, and would come at command. Would stop crying when he heard food being brought in the customary way. Absence of control over bladder or rectum; daily vomiting. Patient is described as having had measles, and is said to have been able to kick up his legs at some time prior to his entrance to the school; but it is possible that this reaction, described by

the parents, was merely the effect of action of the muscles of the back and gluteal region. No history of epilepsy.

2. Family History.—Sister (born, Nov. 6, 1894) is an inmate of the Massachusetts School at the present time, having been admitted at the same time, at the age of 7. There are two other children, not microcephalic. The father and mother were born in Italy, and were about 33 and 23 years of age respectively at time of birth of patient. There are two other children, one of which was older than the patient's sister.

Parents are said to have been normal at time of the birth; birth was normal; and, although it was stated that the labor in the case of patient's microcephalic elder sister was a tedious labor with slow dilatation, the delivery was not instrumental in the case of either of the two microcephalic children.

3. Personal and Developmental History.—Patient seemed to the parents never to have developed mentally. He is described as having been fed but once a day, on bananas only.

4. History of School Progress.—Nil.

5. School Examinations.—Nil.

6 and 7. Practical Knowledge and Economic Efficiency.—Nil except for statements made under *Physical Examination* (see above).

8. Social History and Reactions.—Limited to interest in food on the instinctive level; would continue eating indefinitely if food was supplied. Patient wanted to be let alone.

9. Moral Reactions.—Occasional crying spells, possibly related to appetite.

10. Psychological Tests.—Quantitative tests not made. The microcephalic elder sister, obviously a little superior to her brother, measures 1.3 years of mental age by Binet scale. It is clear that the present case would have measured one year or less.

Waverley School History.—Patient's condition was unchanged throughout his stay. Patient was admitted April 12, 1902, when five years old, and died May 21, 1902.

b) Autopsy.

Notes not available; findings are limited to Gross anatomical examination: Microcephaly, dorso-spinal caries, with antero-lateral curvature; thighs sharply flexed on abdomen, legs flexed on thighs, arms slightly flexed and contracted at elbows.

c) Special Anatomical Description of Brain.

The measurements of the microcephalic brain, after preservation in formaldehyde for 11 years, were as follows:—

Length of left hemicerebrum LLH, 9 cm.

right LRH, 8.25 cm.

Greatest width W 8.75 cm.

Greatest height Heit 5 cm.

Cerebral index $\frac{W \times 100}{\text{Length}} = 97.22$ cm.

Greatest width left hemicerebrum WLH, 4 cm.

right WRH, 4.75 cm.

Arc frontal pole to Rolando left LArc FRo 3.08 cm.

right RArc FRo 3.07 cm.

Arc left Rolando to occipital pole LArc RoOc, 5.2 cm.

right RArc RoOc, 4.7 cm.

The brain gives the impression of being very simple and slightly developed. There seems to be a moderate degree of generalized thickening of the pia mater over the entire brain. The vessels are prominent but fail to show gross changes. It is noteworthy that the left hemisphere is longer than the right. The olfactory sulcus of the left orbital surface is short and possesses distal extremity deflected to the left. The olfactory sulcus of the right orbital surface is straight and extends almost to the anterior pole. The sulci on each orbital surface external to the olfactory sulci are small triradiate sulci whose extremities extend forward and sidewise well toward the margins of the orbital surfaces. Posteriorly these sulci approach the olfactory trigone.

The markings of the convexity are atypical and more markedly atypical on the right side. The frontal lobes consist of but two convolutions, the superior of which are broader than the inferior and marked by a number of short fissures. The inferior frontal convolutions are but slightly indented and fail to cover in the island of Reil. This deficiency of the frontal operculum is more marked on the left side than on the right.

The central area of the left convexity approaches normal in structure, although the frontal sulci run back to cover the precentral convolution. Upon the right side, the post-central gyrus is folded over the precentral gyrus, forming an atypical operculum therefor. The right postcentral gyrus is situated nearly a centimeter anterior to the left. Like the left central area, the left parietal lobe has an abnormal construction; this is divided atypically by the interparietal fissure; the postcentral and horizontal portions of the left interparietal fissure are connected with each other. The anterior third of the left interparietal fissure gives off a short descending branch, which branch separates the submarginal from the angular gyrus.

The occipital lobes upon both sides are exceedingly small and scarcely marked by fissures or depressions. On the left side, the demarcation of the occipital from the parietal lobe is effected by means of the transverse operculum. The general appearance of this area suggests the "Affenspalte"; on both sides the posterior extremity of the calcarine fissure is found to extend to the external surface of the hemisphere. Upon the left side this extremity terminates in a single cleft, pointing laterally. On the right side, the extremity of the calcarine fissure is a cleft running more frontalwards and finally terminating in a T-shape.

The comparatively large temporal lobes are almost entirely without sulcal markings, if we except the left second temporal gyrus, which is crossed by two transverse fissures in its middle and posterior portions. The pyriform lobule is well developed on both sides, especially on the right. Each pyriform lobule is marked off by a distinct *fissura rhinica* (Turner).

The lateral situation of the hippocampal lobes yields a notable degree of exposure of the crura cerebri and this appearance of an exposure of the crura is increased by the comparatively small number of transverse pontine fibers. Upon removal of the pia mater, the transverse pontine fibers are found arranged in bundles which are almost distinct from one another. The optic tracts seem comparatively very large and the olivary and pyramidal eminences upon the ventral surface of the medulla also stand out prominently. The cerebellum appears to be not remarkable on gross inspection.

d) and e) Microscopic Examination and Anatomical and Histological Summary.

Upon section the lateral ventricles show a moderate degree of dilatation. There is a slight subpial gliosis, involving both an increase of cells and an increase of neuroglia fibrils. Further points so far as important are placed in the general summary below.

Summary of Anatomical Examination.—The brain as a whole is very small. The cortex averages roughly 3 mm. in thickness. There are only two convolutional divisions in the frontal lobes. The right post-central gyrus forms an operculum which overlies the precentral nearly throughout its entire

length. The sulci of the precentral area are shallow; the individual gyri (especially on the left) are very narrow — some are not separated by sulci — and form thin fingers of white surrounded by grey cortex. The lateral ventricles are moderately large. In the postcentral (parietal) area, the sulci are deeper than precentral (frontal) but the medullary portion of the gyri is narrow. The descending ventricular horns are widened laterally. The structures at the base of the brain, though small, are not otherwise abnormal. The tapetum, optic radiations, and anteroposterior bundles are present. The striae of Lancisi (Indusium) are very noticeable in the anterior plane. The left is much larger than the right but decreases in size posteriorly until in the region of the Splenium, they are scarcely distinguishable.

The inferior olives stand out prominently from the periphery of the medulla; a distinct cleft exists on their antero-lateral surface, separating them from the surrounding portions, and the anterior arcuate fibers curve in deeply around the depth of this cleft.

The *cortex* is of average thickness (3 mm.). The cell supply is scant in all layers, but notably so in the medium sized and large pyramid layers, especially in the frontal and parietal areas. Many of the Betz cells are thin and fusiform. This seems particularly true of the left side.

The leaflets of the cerebellum are small, but do not lack in normal elements, nor present any anomaly. The blood vessels are not remarkable.

SYNOPSIS OF FINDINGS OF CASE II.

a) Clinical.

1. Physical Examination.—Born September 3, 1876; admitted to the school, April 1, 1893; died March 11, 1897. Characteristic microcephalic with receding forehead; knees stiff and flexed; feet extended; ankles rigid; thighs crossed; right knee crossed left; legs in contracture; hips can be slightly flexed; spastic paralysis of right arm; locomotion by rolling; patient could feed himself by use of left arm and hand; patient unable to walk or sit; head is described as asymmetrical. The right hemisphere of the brain is described at autopsy as having been one third larger than the left, and the skull flattening is described as having been especially marked in the left frontal region. No evidence of epilepsy.

2. Family History.—Born in Provincetown, of American parents; father 25 years of age, mother 22 years of age at birth of child. The microcephalic child was the first, seven other children following, none of whom is described as showing any deformity. The mother's health during pregnancy is described as having been good, and no extraordinary circumstances attended the delivery.

3. Personal Developmental History.—Physician (Dr. Newton) described the patient as having had a paralytic shock, at what time before the age at which first peculiarity was noticed (3 months) cannot now be stated. Another version of the cause is "infantile paralysis," but whether this diagnosis, made in 1876, has reference to epidemic poliomyelitis cannot now be stated. The patient is described as having passed through measles, whooping cough, and chicken pox.

4 and 5. School Progress and Examinations.—Nil.

6. Practical Knowledge.—Able to feed himself with left arm and hand.

7. Economic Efficiency.—Nil.

8. Social History and Reactions.—Patient appears to understand certain things said to him. Unable to talk. (Is described by family as able to say "Mamma.") Patient could make cackling sounds of a loud and shrill nature. By means of these sounds and by gesticulating with the left hand, patient was able to express clearly: pain, pleasure, displeasure, hunger, and thirst; and was apparently able to make the other boys in the ward able to understand these expressions. Patient took interest in events about him, watching the boys at play, liking to look at pictures and bright colors. Patient's hearing was good. He enjoyed music and was able to hum several tunes correctly.

9. Moral Reactions.—Patient is described as gluttonous, swallowing food without chewing. He is described by the family as passionate.

10. Psychological Tests.—No quantitative tests made. Patient would probably measure less than a year.

Waverley School History.—Is sufficiently described above. Death was due to septicaemia following gangrene of extremities.

b) Autopsy.

The description of the autopsy is taken from the report of Dr. Taylor:

The autopsy was made about twenty-four hours after death, the head only being examined. The body was undersized and markedly deformed. The head was markedly microcephalic in type, the circumference $17\frac{1}{2}$ inches; from root of the nose to the occipital protuberance measured 11 inches. The skull was thick, particularly over the parietal regions. Corresponding to two marked depressions in the frontal portion of the brain and easily seen before the removal of the dura were two bony prominences on the inner table of the skull. Dura and pia normal. The brain completely filled the cranial cavity, which was asymmetrical. The left hemisphere was markedly smaller than the right, with abnormal convolutions in both. Very striking at the autopsy was the posterior portion of the brain, including the upper parietal and occipital lobes. The cortex here was so greatly reduced in thickness that fluctuation from the distended ventricle was easily obtained on the left side. The right hemisphere appeared approximately thirty-three and one third percent. larger than the left.

The brain was hardened in formalin, and after hardening weighed 620 grams.

Further examination of the brain 16 years after removal yielded the following measurements:—

Length of left hemicerebrum, LLH, 14.5 cm.

right LRH, 14.5 cm.

Greatest width W 11 cm.

Cerebral index, $\frac{W \times 100}{\text{Length}} = 76$ cm.

Greatest height Heit 5.75 cm.

Greatest width left hemicerebrum WLH, 5. cm.

right WRH, 6. cm.

Arc frontal pole to Rolando LArc FRo 8. Left.

right RArc FRo 9.5 cm.

Arc left Rolando to occipital pole, LArc RoOc, 6.5 cm.

right RArc RoOc, 5. cm.

Frontal pole to corpus callosum, FCorp Cal. 3.2 cm.

Right optic commissure 6 cm.

There is considerable asymmetry in this brain. The hemispheres do not differ materially in length, but the right is considerably broader than the left. This is particularly noticeable at the frontal pole. On the orbital surface the left gyrus rectus is narrower than its opposite, and the convolution which forms the margin is shrunken and shortened. This shortens the distance from the frontal tip to the fronto-temporal angle, and deflects the longitudinal fissure toward the left.

There is a circumscribed area of microgyria about midway the second frontal gyrus on either side, that on the left is more extensive. The third left frontal is complex and the convolutions are well rounded.

The central region marks the beginning of an extremely atypical cortex. The precentral gyrus on both sides is of fair width, and well rounded. The postcentral on both sides is much shrunken and narrowed in its upper half. The fissure of Rolando very nearly cuts the margin of the superior longitudinal fissure on the left, while on the right, its upper extremity is one centimeter from the margin.

The entire parietal cortex over the vertex is much shrunken, the convolutions are very narrow and flat, and on the left a small focus has sunken below the surrounding surface. The normal markings are not made out, on account of the alterations in the cortex. At the parieto-temporal juncture, the convolutions assume a more nearly normal outline. This does not include the upper part of both the supra-marginal and angular gyri on both sides, both of which are severely affected; more particularly the former and the cortical change is more extensive and extreme on the left than the right.

The temporal lobes are asymmetrical temporo-frontal distance L. 4. cm. Rt. 4.5 cm.

Both first temporals are very narrow; the right particularly so. The second temporals are broad with transverse markings. The left hippocampal gyrus is completely hidden by the folding over of the third temporal, and only the extreme anterior portion of the pyriform lobule is seen. On the right, the hippocampus and pyriform lobule are not remarkable.

The occipital lobes are very small and show the same changes on the superior surface as the parietal upper regions; the lateral surfaces are more nearly normal. The posterior extremity of the calcarine fissure extends well on to the outer surface of the occipital tip. On the left, the distortion of the parietal cortex has brought the calcarine fissure for a considerable distance nearly to the upper margin of the hemisphere.

The pons, medulla, and cerebellum are not notable on gross examination.

d) Microscopic Examination.

Nerve fibers have been replaced in many instances by patches of rather dense neuroglia tissue. In the prefrontal sections this condition is marked, especially on the right side; farther back the areas of gliosis show cavitation with numerous glia cells in rather thin encapsulating walls, and a number of large pigment-bearing phagocytes. The major amount of cell loss is in this portion of the frontal region confined to the mesial surface. Farther back the frontal cortex shows thinning of all its layers, except the external layer of small pyramids. More posteriorly the total brain sections demonstrate a special loss in size of the two second frontal convolutions; but this loss is more marked on the left than upon the right side. The mesial gyri in this region are also characterized by extreme fiber loss, and the cells which persist are arranged patchily. The sections here indicate that there are more nerve cells than the number of persistent nerve fibers would lead one to expect. More posterior sections exhibit the same higher degree of degeneration upon the left side and this degeneration is shared by both the second and the first frontal gyri. Sections through the plane of the anterior extremity of the lateral ventricles show a marked dilatation upon the left side, with a complete degeneration of the fibers surrounding the ventricle superiorly, externally and upon the external half of the inferior border, whereas the fibers on the mesial border and upon the internal half of the inferior border of the ventricle are preserved. The fiber communications of the first and second frontal gyri that underlie portions of the brain are represented by only a narrow band of fibers.

When the sections begin to cut the corpus callosum, it is found that this body is made up of a very thin bundle with a small number of stained fibers. The white bundle and the third left frontal gyrus are thinned out and in this region there are many large pigmented phagocytes. The first and second frontal gyri in this plane are almost completely degenerated as is also the tissue of the superior mesial surface. The knee of the corpus callosum is also very thin. The lower portions of the hemisphere appear more nearly normal than the upper portions, although the gyri in the lower portions of the hemispheres are too narrow and long as compared with normal. Some sections exhibit a multiple cavitation in the degenerated areas with the cavities surrounded by a dense gliosis. In a plane still farther back behind the temporal lobes, a considerable degree of satellitosis is found in both superior frontal gyri. The lateral ventricles are markedly dilated, although the left more so than the right. Small areas of

Betz cells are found in the precentral gyri on each side, although the tissue for the most part above the temporal lobes is markedly degenerated. In view of this marked degeneration, the internal capsule does not appear to be so shrunken a structure as one might expect. The superior temporal gyrus is itself moderately involved in the degeneration, more particularly on the left side. The transverse temporal gyri are markedly shrunken. Planes posterior to the above continue to show extreme degeneration of tissues superior to the Sylvian fissure and even including the mesial surface on the left side. Of these gyri the callosal gyri are the least affected. The superior temporal gyri and insulae of both sides show equal degrees of degeneration. On the right side, the inferior parietal lobule shows a certain degree of change, but the alteration of the superior parietal lobule is extreme, if we except the tissue along the longitudinal fissure and upon the mesial surface. Large amyloid granulations are found at the base of the pineal body.

The thinning of the cortex in sections posterior to the above is extreme except in the temporal lobes. Appearances suggest that the right superior colliculus is smaller than the left. The pyramidal bundles are smaller on the left side than on the right, their magnitude being reduced possibly one third. The tapetum and optic radiations are markedly thinned out on both sides, although more extremely on the left. A section from the extreme tips of the right lobe exhibits a curious appearance of cells in islands separated by fibers.

e) Anatomical and Histological Summary.

The interest of this case naturally lodges in the combination of microcephaly, hydrocephalus and posterior-lying focal lesion of the cerebral cortex. It is supposed that this latter lesion may have been due to an old cortical lesion, possibly of the nature of cerebral lesions sometimes occurring in infantile paralysis. The brain is somewhat asymmetrical; in particular the right hemisphere is considerably broader than the left. It is an interesting inquiry what relation may be held between the focal parietal, occipital lesion and the shrunken left frontal region with its circumscribed area of microgyria in the second frontal gyrus.

When we find that the nerve fiber loss has been replaced by patches of rather dense neuroglia tissue, we are bound to inquire whether this latter condition of gliosis is to be regarded as an acquired reaction following the destruction of tissue which had been properly laid down, or whether this gliosis is to be regarded as gliosis relative to fundamental absence of nerve fibers. The patchy nature of the gliosis rather inclines the examiner to the belief that we are dealing with a lesion in some sense acquired. The fact that large pigment-bearing phagocytes are found in the gliotic walls of the cavities found in some areas of gliosis is perhaps not decisive; but phagocytosis is consistent with the hypothesis of acquired lesion.

Again the irregular preservation of nerve fibers about the ventricle (mesial and internal fibers of the inferior border preserved) rather suggests acquired lesion.

What the significance of the multiple cavitation in degenerated areas surrounded by dense gliosis may be is doubtful. We may think of the resemblance of these areas to cavitation in the spinal cord in syringomyelia. Patchy nerve cell and fiber loss, cavitation in areas of gliosis, the occurrence of pigment-bearing phagocytes, to say nothing of the somewhat suggestive history of early brain lesion, may well lead us to regard this case as one of secondary amentia in the sense of Tredgold. Whether we may add to this list of factors the presence of satellitosis in certain areas is questionable. On the whole, however, in the present stage of our knowledge concerning satellitosis, it would appear that the finding is rather indicative of an active or acquired lesion. (One here bears in mind the satellitosis about nerve cells in poliomyelitis and other conditions, which may be repeated experimentally; but one also has to bear in mind the satellitosis in certain cases of atrophy of the brain in the senile period where the satellite cells may be regarded possibly as reactive to the condition of atrophy.) It might be that hypoplastic

nerve cells could be affected by satellitosis in ways identical with those of the condition just mentioned. The presence of large amyloid granulations at the base of the pineal body may have significance in these directions but we must at present omit consideration thereof.

The greater degree of disease on the left side of the brain is supported by the smaller size of the pyramidal bundles on the left side above the decussation.

In our judgment the case then is pretty clearly one of secondary amentia.

SYNOPSIS OF FINDINGS IN CASE III.

a) Clinical.

Little is known as to Case III although the patient, D. C., born in 1863, was a somewhat well-known figure in Boston and vicinity all his life, which was passed for the most part outside of institutions. When outside of institutions, patient was regarded as a harmless microcephalic, alternately the pet and the butt of the community. He was of a vagrant tendency, unable to support himself but able to curry favor with various kindhearted persons, who would keep him in their houses for a few days or weeks until the vagrant spirit set in once more. He was known as "Peanut head" by the children, and became later known as "Zip," being a namesake of a subject exhibited at circuses and variety shows. In fact, the patient is said to have been exhibited for a time in a nickel theatre in Boston under the name of "Zip, the wild man of the Philippines." The patient entered the hoax with intelligence, wore a buffalo robe, had his hair cut in a peak behind, and rattled a tin cup, saying "*Education! Education!*"

The patient, born of Irish-American parents (father alcoholic), is said to have been a seven-months child, born in a fracas between his father and a policeman. The patient's father is said to have been occupied with beating the mother when the policeman interposed. The policeman's club is said to have glanced off onto the head of the mother, who died within twelve hours of giving birth to the patient.

The patient is said to have learned to walk and talk at the usual time, was unable to get through the primary school, but is said to have picked up reading and writing. He was at first in a Catholic home; later in a home for destitute children; still later in the State Infirmary in Tewksbury, where he was operated upon for rupture; and he was at the Bridgewater State Farm in 1903. The patient had no abnormal sexual tendencies. He was easily susceptible to alcohol. It is said that at the age of 30 he had a fit, probably epileptic in nature.

The history of the patient just before his death makes a somewhat moving story. Upon good authority, it is related that he was in perfect health until September 15, 1908, being six days before he died. Upon September 15, the patient endeavored to steal a quarter from a kind hostess who had kept him in her house for a number of days, as she had done at previous times. He was found out in his design and was upbraided roundly by his hostess for being a liar. The patient became furious, went to his room in his hostess' house, began to mutter to himself and to tear his hair, and then refused to eat or drink. He is said not to have eaten anything until his death. He was admitted to the Danvers State Hospital *in extremis*, September 20, 1908, and died a few hours later.

b) Autopsy.

Head and trunk were examined by E. E. Southard and the cord by M. M. Canavan.

White male, age 45, 126 cm. long; weight, 88 lbs. Trunk symmetrical; thorax narrow; costal angle acute. Shoulders and hips of equal width. Spinal column straight. Extremities symmetrical and of appropriate length with respect to trunk. Head microcephalic. Skull symmetrical.

Measurements: Glabella-occipital length,	14.5
Basi-bregmatic height,	12.
Vertical index,	81.
Minimum frontal diameter,	9.5
Greatest parietosquamous breadth,	11.5
Cephalic index,	79.
Horizontal circumference,	43.

The glabella is prominent. The general outlines are shown in the accompanying sketch. Extremities rigid. Slight greenish discoloration of abdomen. Pupils: left 5 mm., right 4 mm.

Peritoneal cavity.—Serosa and contents normal. *Appendix* infracecal, free, 7 cm. long. *Mesenteric lymph nodes* not enlarged. Omentum thinly clad with fat.

Pleural cavities.—Slightly moister than normal. Adhesions absent. Roughening of pleura at both apices, in areas less than 3 cm. broad.

Pericardial Cavity.—Not remarkable.

Mediastinum.—No sign of thymus.

Heart.—Weight, 210 grams.

Measurements: T. V. 11. cm. P. V. 5 cm. L. V. 1.5 cm.
M. V. 9. cm. A. V. 6 cm. R. V. 0.4 cm.

Muscle normal. Endocardium shows a slight thickening adjacent to aortic valve. Valves normal. Cavities contain cruor clot. Coronary arteries normal.

Lungs.—Left 355 gr.; right 535 gr. Both edematous and congested behind and below. The dependent portions of both lungs, especially right, are coarsely mottled and non-retractile, and contain bronchial plugs of semifluid pus. There is no palpable deposit of fibrin on the pleurae. The larger bronchi are free from pus. The vessels are normal. *Bronchial lymph nodes* not remarkable.

Spleen.—Wt. 105 gr. Fir; dark red, without thickening of trabeculae or enlargement of malpighian bodies. Spleniculus near hilus below.

Gastro intestinal tract.—Stomach: Contains little or no fluid. Walls covered with brownish mucus which is tenacious. Duodenum negative, also jejunum. In various parts of the ileum greenish black semi-solid pasty material seen. Walls covered with mucoid exudate. No ulceration or hemorrhage seen. The colon also for some distance after passing ileocecal valve shows black content, but at the sigmoid the content is only cheesy mucoid material. Rectum negative.

Liver: Wt. 990 gr. Border sharp. Substance of normal consistence and nut-brown in color. *Gall bladder* not remarkable.

Pancreas.—Small.

Adrenals.—Show no lesion.

Kidneys.—Left weighs 170 gr. Measures 13×5 cm., is very red and drips blood on section. The capsule strips with fair ease leaving a smooth surface. The cortex is 1 cm. thick, the pyramids are a large distance from pelvis to capsular surface, being 2.5 cm. The pyramids are uniformly diffusely red, while the cortex, mahogany in color, is markedly injected. Kidney substance bulges on section. Two ureters of usual size connect the kidney with the bladder. The right kidney measures 9×2.5 cm.

Two yellow-white pouches 2.5×3 cm. in diameter, spring from either pole of the kidney and descend to bladder as independent tubes 1.4 cm.—1 cm. in diameter. They are 14–18 cm. in length and above the fundus of the bladder appear to unite and descend on right side of bladder. The bladder is deeply congested and in the upper and right side numerous cysts, closely set, appear in wall. Dissection of the ureters shows fine openings into the bladder, two on the left side corresponding with the two ureters and situated appropriately with relation to the trigonum, two on the right side symmetrically placed with respect to those of the left side but draining only the external of the two right ureters. The internal of the right ureters opens into the bladder by a relatively large orifice situated on the lateral surface near the summit.

Organs of neck.—Thyroid weighs 15 gr. Normal on section. Under and along upper border of common carotids a glandular bit of tissue held together by adipose and areolar tissue seen. It is yellow in color and contains numerous glistening red bodies.

Aorta.—Smooth and elastic throughout.

Genito urinary.—Testes yellow-white, small, edematous, do not thread well.

Head.—*Hair* stiff, black, closely cropped. *Scalp* thick and may be readily gathered into loose folds. *Calvarium* moderately dense. *Dura mater* not adherent to calvarium. *Sinuses* not remarkable. *Middle ears normal.* *Pituitary body normal.* Brain wt. 610 gr. Placed in formalin for later description. Brain reweighed after formalin containing 8% NaCl, 615 grams.

Measurements: Cerebrum, antero-posterior,	12.5 cm.
“ dorso-ventrally,	9. cm.
“ laterally,	10.75 cm.
Cerebellum, antero-posterior left,	4.5 cm.
“ “ “ right,	4.5 cm.
“ greatest dorso-ventrally,	3.5 cm.
“ laterally,	8.5 cm.

Width of pons between origins of 5th nerves, 3 cm.

Antero-posterior basal measurement of pons, 2.5 cm.

Pia mater, everywhere clear. Vessels show moderate injection; small pacchionian granulations alongside longitudinal fissure from middle of superior frontal gyri as far back as superior parietal lobules. Sylvian and Rolandic fissures well marked, almost symmetrical. Gyri of fairly even width. Gyri and sulci so disposed as to yield the impression of a normal though small brain. No sign of Affenspalte. Upon superficial examination, besides Rolandic and Sylvian fissures are made out (before stripping pia), ascending ramus of Sylvian, second and third frontal sulci, first frontal sulcus (interrupted), intraparietal sulcus with branches, first and second temporal sulci, parieto-occipital, calcarine, collateral and callosomarginal sulci. Orbital surfaces normal. Slightly asymmetrical markings. Cerebellae laminae not remarkable possibly in places wider than usual, notably in Amygdala. The inferior vermis is either absent or obscured by close proximity of inner surfaces of the amygdalae.

Anatomical Diagnosis.

Unequal pupils.

Chronic pleuritis.

Slight chronic endocarditis.

Pulmonary congestion.

Purulent bronchitis.

Acute nephritis.

Cystitis, acute.

Cystic formation in bladder wall.

Abnormality of ureters.

c) Special Description of Brain.

The *precentral fissure-complex*. In the frontal cortex, including and lying in front of the fissure of Rolando, there is one principal fissure, triradiate in form corresponding apparently to the precentral sulcus, frontal from which extends the inferior frontal sulcus. Above the dorsal extremity of the vertical ramus and separated from it by a narrow, plump gyrus, is a short, deep fissure 2.3 cm. in length which cuts the superior margin at right angles. (Sulcus cruciatus?). This sulcal arrangement divides the frontal cortex into two gyri, both of which anastomose with the precentral and anteriorly with each other. The superior frontal convolution is broad and long, and is marked by four short fissurettes which generally

follow an oblique line. The inferior frontal is short and broad, and is marked by three shallow fissures, and a deep ascending Sylvian fissure. Very far frontal is a T-shaped sulcus, whose stem runs from a point very near the fronto-Sylvian angle and 0.6 cm. from the orbito-frontal margin to a point 0.8 cm. from the superior margin where it opens into a longitudinal sulcus 2.1 cm. in length, slightly concave mesad.

Temporal and Occipital Fissures.—The parietal lobe presents an anomalous fissure-complex—the postcentral sulcus (1) cuts the margin of the superior longitudinal fissure and extends upon the mesial surface for a short distance. The horizontal interparietal is represented by a very short ramus (2) (1.5 cm.) which springs from the postcentral at the junction of the middle and lower thirds, mesad to this horizontal ramus and 1.4 cm. from the meso-dorsal margin is a deep, curved, horizontal fissure, slightly curved with the convexity mesad. This fissure does not descend vertically into the cortex, but obliquely outward, thus forming a thin operculum which overlies the tips of the horizontal convolutions which form the superior parietal lobule. At its occipital extremity this sulcus opens into a horizontal one 4.3 cm. in length which lies 1.5 on the meso-occipital surface and ends laterad in a forked extremity. The lower lip of this fissure is opercular in character and suggests an *Affenspalte*. The corresponding sulcus on the left side is quite simple, not at all resembling the one just described.

The superior parietal lobule is narrow and its gyri vary in width from 1.2 cm. to 0.4 cm. The supra-marginal gyrus is fairly broad—0.9 cm. in width—but the convolution is short. It anastomoses anteriorly with the postcentral and posteriorly by means of a bridging arm, with the angular gyrus. The latter is made up of three parts which extend horizontally and assume a fan-shaped outline. The gyri are comparatively broad and almost free from ramifications. This gyrus encroaches upon the occipital lobe which is very small. The tips of the occipital lobes of both sides point away from the median line thus exposing a portion of the cortex which is ordinarily found on the approximated mesial surface.

The Temporal Lobe.—The temporal lobe is divided by two very simple fissures. The gyri are relatively broad, smooth and well-rounded, with short shallow fissures at their bases. The sulci on the basal surface are very simple. A deep fissura rhinica separates the uncus definitely from the tip of the temporal lobe. The *inferior temporal sulcus*: It is deep with sloping walls, and is interrupted about midway by an arm from the fusiform gyrus which anastomoses with the third temporal convolution.

The Left hemiserebrum.—The configurations of the area anterior to the Rolandic fissure on the left hemisphere are almost identical with those on the right, in every detail.

The temporal lobe also is uniform with the right.

The parietal lobe.—The ascending ramus of the interparietal sulcus is separated from the horizontal and descending portions by an anastomosing arm between the postcentral and superior parietal gyri. The posterior extremity of the horizontal limb enters into a roughly star-shaped formation. The posterior portion of the second temporal gyrus, representing the area of the angular gyrus, is a separate fragment; below this a continuation of the second temporal fissure extends backward to within 3.2 cm. of the longitudinal margin.

The occipital lobe is noticeably larger than that on the right. Its markings are somewhat complex and may be best studied on the figures and photographs.

The configuration of the basal surface is uniform with the opposite side.

The meninges are not particularly remarkable. The pia is slightly thickened and the vessels injected.

There is noticeable occipital asymmetry; the right side is shorter than the left, and points away from the median line.

The orbital surfaces incline upward to a marked degree both postero-anteriorly and meso-laterally, thus partly exposing them to lateral view. The sulcus pattern here is a very simple tri-radiate one, very similar on both sides. The olfactory bulbs are 3.5 cm. in length, and not notable in development.

Rt. precentral are 9.5 cm.
 " postcentral " 8. "
 L. precentral " 10. "
 " postcentral " 8. "

The markings on the hemispheres are very nearly symmetrical. There is lack of development of both frontal and parietal cortex; possibly involving the former to a greater degree.

The frontal lobes are very pointed at the extreme pole and are made up of only two convolutions. The superior is somewhat narrower than the inferior and is marked with short, oblique fissures, and triangular depressions. The Island of Reil is exposed on both sides: somewhat more on the left than right. At the base of the frontal gyri, and separating them from the precentral convolutions on either side are short, deep, transverse sulci, which resemble the sulcus cruciatus of the dog's brain. In fact this specimen in general contour bears a rather noticeable similarity to the brain of a dog. The convolutional pattern of the central region is very simple. The pre- and post-central gyri on the right are curved only at the genua. The Rolandic fissure on this side points occipitalward at its upper extremity, and nearly cuts the margin of the hemisphere. On the left side the precentral gyrus is interrupted at the point corresponding to the inferior genu; the upper knee is lacking. The Rolandic fissure on this side is formed at its upper extremity by a formation with a convolution of good width between it and the margin of the hemisphere.

The horizontal portion of the right interparietal sulcus is separated from the postcentral portion by an annectant gyrus, between the superior and inferior parietal lobules. It curves around the supra-marginal and angular gyri, and seems to form an offset to a portion of the superior parietal lobule. The latter is narrow and marked with transverse fissures. On the left side, the inferior postcentral (descending interparietal) fissure is continuous with the horizontal interparietal.

The superior post central is separated from the former by an annectant gyrus connecting the post central with the superior convolution. A similar opercular formation exists on the left as on the right, but it is made more complex by a reduplication caused by the presence of an additional sulcus which extends with a single interruption, in a curved outline from the posterior extremity of the parieto-occipital fissure to the base of the second temporal from the angular gyrus.

The occipital lobes are very small, and are marked by a few short fissures. The calcarine fissure extends upon the outer surface, ending in a single upward curve on the right, and in a T formation on the left.

The temporal lobes are remarkable only for their simplicity. The gyri are nearly straight, and almost entirely without markings. The first and second convolutions are of good width and well rounded. The third is somewhat narrower and flattened.

The pyriform lobules are well developed, the right apparently more so than the left and are limited anteriorly by a well marked fissura rhinica (Turner) (?).

The markings on the base of the brain are as singularly symmetrical as they are on the upper and lateral surfaces.

The mesial surfaces are not described because the hemispheres were not separated.

d) Microscopic Examination.

The total brain sections stained by the Weigert myelin sheath method permit the observation of a marked gliosis in the white matter in the frontal region, especially about the vessels. In places the cellular gliosis is general and marked and in particular there is an abundance of spider cells in the subpial region. Satellitosis is found in addition to the above mentioned cellular gliosis and in certain areas farther back in the frontal region (sections № 146-151) there appears to be a particular degree of satellitosis about the cells in the lenticular nucleus. Also in this posterior portion of the frontal region, the gyri

begin to show a more marked thinning of their cell layers than is found farther forward. The mesial surface of the uncus of both sides and the basal tissues lying between show a marked subpial gliosis. Large cells were demonstrated in the appropriate region about the ventricle and there was a marked subependymal gliosis with pigmented glia cells and certain large round cells. These findings were especially noted from the mesial angle of the thalamus.

Practically no areas fail to show general cellular gliosis but thinning of the cell layers is shown in addition to that mentioned above for the frontal areas (sections #156-186) also in the parietal areas (sections #331-356). The tapetum, optic radiations and longitudinal bundles are intact. The tissue permitted the employment of Van Gieson's stain which demonstrated the subpial gliosis especially well, as also a perivascular gliosis in many places, with lymph spaces apparently containing glia cells (no exudate is present in any area studied). The stem of the olfactory bulb is found infiltrated with amyloid bodies. There was a slight focal thickening of the intima in the basilar artery.

The blood vessels of the white matter appear numerous and there is a good deal of perivascular gliosis. No abnormality of vessel walls is anywhere shown.

e) Anatomical and Histological Summary.

The gyri are everywhere narrow — about 0.8 cm. at their summits — and simple in arrangement. The primary and secondary sulci are of ordinary depth, not complicated by collaterals, and their walls, as a rule, are not approximated at the summits, though the sulcal floor is not exposed.

The frontal lobes are small, and pointed at the anterior poles; the orbital lobes lie in a more or less vertical plane. The markings are notably uniform on both sides.

The temporal lobes are comparatively large and are very simply convoluted.

The parietal lobes present a greater diversity of sulcation than any other part of the brain. The pattern of the two sides varies considerably. This is described in detail in another place.

The occipital lobes are quite at variance in size, the right being considerably shorter than the left. A deep transverse sulcus about midway between the parieto-occipital fissure and the tip of the occipital lobe forms a relatively large operculum and seems to account for the occipital shortening. This lack of uniformity in the size of the occipital lobes is plainly seen on the basal surface. (See illustration).

The brain was not divided longitudinally between the hemispheres and consequently a detailed examination of the mesial surfaces was not made.

Angle of Rolando with long fissure, right = 53°

“ “ “ “ “ “ left = 53°

Temporal tip — frontal pole = 3.1 cm.

“ “ occipital “ = 10.3 cm.

There are varying degrees of satellitosis nowhere marked in the cortex, but rather more extreme in degree in the basal gray matter.

The cortex averages about 3 cm. in thickness.

The cortical cell-supply seems somewhat reduced in amount, especially in the frontal and parietal lobes. Betz cells prominent. The lack seems to be mainly in the outer layers of medium sized and large pyramids — possibly at times the inner layer of large pyramids.

There is considerable subpial gliosis throughout. This is particularly true on the base of the brain between the crura cerebri and the base of the olfactory trigone, especially in the temporo-frontal angle, where the glia network is infiltrated with amyloid granules.

There is also considerable subependymal gliosis — both cellular and fibrillar with pigment in the glia cells. This is confined mainly to the opposed surfaces of the optic thalamus.

SYNOPSIS OF FINDINGS IN CASE IV.

a) Clinical.

Case IV, like Case III, is a Danvers State Hospital case. The patient, M. S., stated to be 62 years of age at death, September 27, 1911, was under hospital observation only from July 26th to her death. The patient was an old almshouse case (Salem and Beverly).

Physically on admission the patient was 4' 8 $\frac{1}{4}$ " tall, and weighed 111 pounds, with arteriosclerosis, slightly enlarged liver, teeth absent, albuminuria, impairment of vision and hearing, thick speech, and a tic of the right side involving head and shoulder.

The meagre history of the patient indicates that she was of old American stock. She had been regarded for the twenty-eight years during which she had been under almshouse observation, as feeble-minded. She was not selfsupporting although she would work, receiving a dollar or a dollar and a half, for a week or more, ranging up to two or three months. At the end of her employment, she would leave with her clothes tied up in a bundle covered by a cloth. Whenever the patient appeared upon the street, she attracted much attention and had a crowd of small boys following her. The tic observed at the hospital was apparently of long-standing and it is said that the twitching was more noticeable when the patient was pleased.

Shortly before admission to Danvers the patient had become untidy. After admission, the patient complained of headaches, was at times restless, was markedly amnesic; did not know the date or her whereabouts, and her attention was hard to obtain. Patient apparently reacted to auditory and visual hallucinations. She said she had seen little women sit on her knees and that they had blue eyes and red hair.

b) Autopsy.

Body of a well developed, well nourished, white female 141 cm. in length. Rigor mortis present everywhere. Skin smooth, hair brown, rather thin. Pupils, right 6 mm., left 5 mm. No teeth on either jaw. No glandular enlargements. No decubitus. Tibial crests smooth. Face asymmetrical.

Ventral Section.—Panniculus over thorax .8 cm., over abdomen near umbilicus 2 cm. Muscle good color. Omentum extends to umbilicus, moderately filled with fat. Lower border of liver extends 8 cm. below ensiform, lower border of stomach extends 6 cm. below ensiform. Few adhesions between omentum and right parietal peritoneum. Adhesions about spleen. Appendix retrocedent, lies over brim of pelvis 5 cm. in length, mesentery throughout. Peritoneal mesentery lymph nodes slightly enlarged, no fluid in abdominal or pelvic cavities. Uterus in right side of pelvis. Diaphragm arches to 4th interspace left, to 4th interspace right. Sternal bone marrow well colored. Internal mammary arteries are not sclerosed.

Thorax.—Left lung adherent along entire posterior region. Adhesions in right lung lie between middle and lower lobes and pericardium, and between the upper, middle and lower lobes. Apex free. No fluid in the pleuric cavity. Anterior edges separated by 2.5 cm. Precordia exposed. Pericardium contains 2.5 cc. of clear straw colored fluid.

Heart.—Greatest width 10 cm., greatest thickness 8 cm. Epicardium contains a small amount of fat. Over the right ventricle is a milk patch slightly irregular in outline, approximately 2 cm. in diameter. Superficial vessels slightly tortuous. Heart contains fluid blood. Weight 225 grams.

Measurements: T.V. 12 cm. P.V. 7 cm. M.V. 8.5 cm.

A.V. 7 cm. L.V. 1.3 cm. R.V. .5 cm.

Endocardium grey, thickened, aortic valve shows slight thickening at line of attachment of cusps,

mitral valve thickened along border. Tricuspid slightly thickened, pulmonary lies flat against wall and shows no thickening. Interauricular septum not intact. Foramen ovale is patent but is functionally closed. Coronaries are free from sclerosis. Arch of the aorta smooth.

Lungs.—Left lung weight 345, adhesions between upper and lower lobes. Upper lobe air containing throughout, a small fibrous scar at the apex. On section posterior portion darker but crepitant. Lower lobe deep red mottled in lower portion, floats in water. Bronchi in lower lobe congested, upper lobe nothing of note.

Right lung weight 325, adhesions between upper and middle lobes, air containing throughout. Small scar on anterior surface near apex. Upper lobe pale, lower lobe slightly congested; lungs float in water. Bronchi slightly congested. Bronchial lymph nodes not enlarged.

Abdomen: Spleen.—Weight 50 grams. Measures $9.5 \times 5 \times 1.5$ cm. Capsule grey, slightly wrinkled. On section soft, mottled. Trabeculae and Malpighian bodies distinct.

Gastro-intestinal Tract: Stomach.—Lesser curvature 20 cm., greater curvature 26 cm. Stomach filled with about 100 cc. of thick yellow mucus. Mucous membrane slightly congested, rugae distinct, no hemorrhages or ulcers.

Intestines filled with a pale yellow fluid, fecal matter and mucus. Intestines thin walled throughout. Slight congestion of duodenum and jejunum. Peyer's patches not enlarged, no hemorrhages or ulceration. Mucous membrane of colon slightly congested, no hemorrhages or ulcers.

Liver.—975 grams, 20×20 in quadrate lobe $\times 13$ in left lobe, 5 cm. in thickest portion. Border well rounded, on anterior surface of quadrate lobe near upper border are three furrows 3.5 cm. in length. On section brownish, lobulation distinct not friable.

Gall Bladder.—Filled with dark, green brown bile.

Pancreas.—13 cm. long by 2.5 cm. in width.

Adrenals.—Right adrenal weighs 4.8 grams, left adrenal weighs 5 grams. On section firm.

Kidneys.—Right kidney weighs 110 grams, measures $10.5 \times 5 \times 3$ cm. Capsule strips readily, cortex pale, .7 cm. Vessels slightly injected. Pyramids slightly more congested than cortex. On section substance bulges slightly beyond capsule. Left kidney weighs 135 grams, measures $11 \times 5.5 \times 3.5$ cm. Pale, otherwise like the right.

Bladder.—Not unusual. Retroperitoneal lymph glands slightly enlarged and darker than usual.

Neck Organs: Oesophagus.—Nothing of note.

Thyroid.—Fairly symmetrical. Weight 12 grams. Left lobe a little more compact than right lobe.

Larynx, Tongue, and Tonsils.—Nothing of note.

Pelvic Organs.—External os of uterus was closed, canal filled with mucilaginous secretion. Uterus atrophied, shortening of right broad ligament and is adherent to ovary on this side.

Ovary is atrophied, left tube apparently normal.

Rectum, nothing of note.

Head.—Calvarium dense, measures frontal 1 cm., temporal .3 cm., occipital .8 cm.

Large amount of diploe. Scalp not unusual.

Dura mater not adherent to calvarium, slight thickening in frontal portion.

Few adhesions dura and pia over vertex and along longitudinal sinus. Few adhesions between tip of temporal lobes and dura. Lateral sinus of left side contains liquid blood, right side is filled with a firmly adherent clot. Pituitary soft.

Right ear drum thickened with one small perforation of the drum. Left slightly thickened.

Pia Mater slightly thickened notably over vessels over vertex.

Pons and cerebellum weigh 125.

Brain firm, with no marked atrophy of convolutions. Slight flattening in parietal region of right side, left hemisphere appears well rounded. Ependyma free and smooth, no sclerosis in basal vessels.

Brain weight 1215 grams.

Anatomical Diagnosis.

Well nourished.	Fibrous scars at apices of both lungs.
Rigor mortis.	Acute bronchitis left.
Unequal pupils.	Small spleen.
Asymmetry.	Acute gastritis.
Chronic peritonitis.	Acute nephritis.
Chronic perisplenitis.	Enlarged retroperitoneal lymph nodes.
Enlarged mesenteric lymph nodes.	Uterus and ovaries atrophic.
Uterus in dextraposition.	Calvarium dense.
Chronic adhesive pleuritis of left lung.	Perforation of right ear drum.
Chronic epicarditis.	Slight chronic pachymeningitis.
Chronic endocarditis.	Slight chronic leptomeningitis.
Chronic aortic and mitral endocarditis.	Brain weight 1215 grams.

c) Special Anatomical Description of Brain.

After preservation in formaldehyde, the following further description of brain was made: —

The brain is dolichocephalic in type. There is slight asymmetry particularly at the poles, the left in each case being more pointed, and the right occipital tip points away from the median line in a slight degree.

The pia is moderately thickened, and its vessels injected. There are many arachnoid villi along the superior longitudinal fissure. The convolutions throughout are rather narrow, but fairly well rounded, and moderately complex. There is slight opening of the sulci throughout.

The primary sulci of the frontal lobe are not clearly defined. The first can be traced with some difficulty, the line being broken and irregular. On the left it is interrupted by three annectants; on the right the walls interdigitate in a way to make it unclear. The remainder of both lobes is marked by generally transverse convolutions.

The precentral gyrus is continuous on the right; on the left it is cut across by the first frontal sulcus. The postcentral sulcus is very narrow. At about midway its length an annectant connects it with the inferior parietal lobule on both sides. The fissure of Rolando on both sides forms little less than a right angle with the superior longitudinal fissure. Their upper extremities cut the superior margin, and extend upon the mesial surface. The lower extremity on the left is separated from the fissure of Sylvius by the convolution forming the operculum; on the left it cuts through the operculum and extends into the Sylvian fissure.

The convolutions of the parietal lobes are narrow, and complex with very slight separation of their summits. On the right the parts of the interparietal sulcus are continuous; on the left they are interrupted by annectants and all three are separate.

The occipital lobes are not remarkable except for the slight asymmetry already noted.

(Mesial surfaces are not photographed.)

The only feature of the base of the brain worthy of note is the asymmetry of the pyriform lobules. The right is larger and considerably more prominent than the left.

The frontal sections show both lateral ventricles much dilated, except in the descending horns; the optic thalamus and the horizontal portion of the caudate nucleus are considerably flattened. The subiculum gyrus hippocampi also is much flattened and shrunken.

The cerebellum is notable only for the apparent lack of uniformity between the two dentate nuclei.

d) Microscopic Examination.

From the notes of a partial microscopic examination, the following is abstracted: —

The left and right prefrontal areas exhibit a marked gliosis with the appearance of a great numerical increase of cells in all layers. Many of these cells are of a type best described as shadow cells. The plexiform layer shows coarse glia fibers. The remainder of the frontal region exhibits identical changes.

In the white matter underlying both the left and right precentral gyri, there were many ganglion cells largely of the fusiform type ordinarily found in the undermost layer of the cortex. Although there were numerous corpora amylacea in the white matter, there was no gliosis and there was no alteration in blood vessels. The cortex of this region showed a slight degree of satellitosis with a slight subpial gliosis. There appeared to be a focal loss of nerve cells effected in various places of the laminae, except the layer of small pyramids. It is estimated that many Betz cells are smaller than normal. Their protoplasm is granular and there is marked increase of yellow pigment. There are frequent shrunken cells and shadow cells in all layers. The postcentral regions of the two sides are slightly better off as to cell shrinkage than the precentral gyri.

The intermediate postcentral regions also show a considerable degree of subpial gliosis and numerous corpora amylacea. Upon the right side there appears to be a thinning in the layer of large pyramidal cells upon the summit of the gyrus examined. There is no such finding upon the left side. There is a suggestion of increase in glia cells throughout the white substance underlying the intermediate post central gyri.

There is a slight gliosis in the white matter of the calcarine areas. Under the transverse temporal gyri are numerous dislocated ganglion cells in the white substance, resembling those mentioned under the precentral gyri.

The area of Broca shows cellular gliosis with corpora amylacea, a moderate degree of general nerve cell atrophy and a thinning out of the layer of internal large pyramids from the summits of the gyri examined. In the subpial layer are many coarse neuroglia fibers.

The hippocampal gyri, cornu ammonis and pyriform lobules show an unusual degree of subpial gliosis and infiltration of corpora amylacea. There is also a gliosis under the ependyma of the ventricles sectioned at this point. There were a number of cells staining palely with colorless spaces about the nucleus, including some shrunken cells with non-staining nuclei and elsewhere were some examples of the shadow cells above mentioned. There is occasional satellitosis but not confined to special laminae.

The spinal cord and medulla show a marked fibrillar gliosis of the periphery and about the central canal. The posterior columns show a considerable infiltration of corpora amylacea. There appears to be a degree of perivascular infiltration in the posterior fissure.

e) Anatomical and Histological Summary.

The brain of this case shows an atrophy or aplasia of the type with flaring sulci suggestive of a condition in which the white matter is relatively better preserved than the grey. The left side appears slightly more hypoplastic or atrophic than the right. The parietal lobes exhibit particularly narrow convolutions and may indicate a certain tendency to microgyria. The left pyriform lobule is smaller than the right. (This appears accordingly not to be a case of cruciate asymmetry in the sense of case V, for example.)

Employing the microscopic examination for the purpose of determining whether this case is one of acquired lesion, we find a marked gliosis with apparent great numerical increase of cells in many layers. We find a coarse fibrillar gliosis of the plexiform layer in places. We find a considerable variation in degree of gliosis in different places but these findings are consistent enough with the hypothesis of relatively recent changes in a subject of 62 years.

Likewise we may logically dispose of the satellitosis found in certain places as well as the over-pigmentation of certain nerve cells. The shrunken nerve cells, so-called shadow cells, are consistent enough with the hypothesis of relatively recent chronic change. In fact, we should probably be at a loss to determine whether there was any evidence of fundamental change suggestive of long-standing lesion if it were not for the dislocated ganglion cells in the white matter in certain regions. It is important to raise the question whether the slight degree of perivascular infiltration in the posterior fissure of spinal cord in places is to be regarded as a sign of old syphilis. The suspicion must at least be raised in the case, although the data of Wassermann reaction are not available. There are in the body at large no special signs indicative of old syphilis (enlargement of mesenteric and retroperitoneal lymph nodes, valvular and parietal endocarditis, etc.).

The case is of peculiar value in emphasizing the difficulties which attend a decision as to inborn and acquired lesions in cases of elderly subjects. Of course the majority of the feeble-minded fail to reach the sixties, possibly for reasons inherent in their general make-up. This case then must be used as a limiting instance in our total larger series.

SYNOPSIS OF FINDINGS IN CASE V.

a) Clinical.

Case V has been already published in Southard's monograph on dementia praecox, from which the following condensed history is taken:

C. B. was a boy of 15 when he was committed to D. S. H., and died there a year and four months later of *typhoid fever, ulceration, and peritonitis*. The mental diagnosis was eventually considered to be *dementia praecox*.

Mother nervous and melancholy during her pregnancy with this boy; hard usage and neglect by husband complicated the pregnancy. From an accident to the boy at seven, is said to date a change of character, with refusal to go to school, fretfulness, and nervousness. At 14 another accident to back and head. An inmate of a truant school for two periods of three and two years respectively. Uncle a patient at state farm.

Auditory hallucinations, refusal to eat, nervousness, and certain delusions antedated commitment by only a week. (Masturbation had begun four or five months before, but had probably ceased.) Insomnia is said to have lasted four nights after onset. *Food poisoned. Passers-by or Indians were to kill him* (given to blood-and-thunder stories). "*Had never done anything to gladden America,*" "*Traitor,*" "*Going to be shot.*"

Cyanosis of hands; gait staggering (no Romberg); right cremasteric reflex not active.

After eight months' observation it was thought that the patient really belonged in the moron or subnormal group of defectives, and in the quasi-criminal class. A little over 11 months after the delusional episode upon which he was committed, patient developed a spell of disturbance which lasted 10 days. In this spell, patient was noisy, threatening, profane, denudative, given to disconnected and incoherent talking, lost weight and grew pale. Almost three weeks later typhoid fever developed, and death followed from peritonitis.

b) Autopsy.

Summary.— Aside from the typhoid fever lesions, there were bronzing of skin, unusually small adrenals (questionable glycosuria had appeared on entrance but later disappeared), a small thyroid, slight sclerosis of aorta and right auricular endocarditis; cardiac hypertrophy, chronic myocarditis, pleuritis, and pericarditis.

Gross frontal sections show the cortex of fair and uniform width throughout.

There is some apparent atrophy at the anterior temporo-insular junction, which leaves the adjacent parts unapproximated.

The cavity of the right lateral ventricle is larger in all its diameters than that on the left, although the difference is only moderate in degree.

There is nothing remarkable about the basal nuclei or the subthalamic structures.

d) Microscopic Examination.

The Weigert-Myelin sheath preparations show good fiber connections in all areas examined. Comparisons were made with the drawings in Campbell's "Localization in Cerebral Function." Evidences of gliosis were as follows: —

The prefrontal tissue shows a moderate increase in the plexiform layer, involving not only an increase in a number of cells but in the number of fibrils. There is no gliosis elsewhere. Although there are frequent ganglion cells in the white matter, there is no notable neuroglia increase in this locus. The prefrontal region showed occasional bi-nucleate neuroglia cells supplied with fibrils in the plexiform layer; but there is no marked gliosis elsewhere.

The same description fits the postcentral tissue, except that there are groups of satellite cells in various layers (right postcentral) as a rule surrounding the small nerve cells.

The superior and inferior parietal regions show similar glia pictures in the plexiform layer. From the standpoint of gliosis, accordingly, the cerebral cortex of this case exhibits in all areas, so far as examined, a moderate degree of cellular and fibrillar gliosis of the plexiform or subpial layer, but fails to show gliosis in other layers, except in the specimens examined from the right postcentral region.

As against the neuroglia picture, we may consider the nerve cell pictures. Of course the excellent preservation of the fiber connections as above noted would indicate that there should be no extensive degree of cell loss. What has so far been found may be summed up as follows:

The prefrontal region (for example, on the right side) shows a suggestion of thinning out of the nerve cells in the supragranular layers; at the summit of the gyrus the cells here are often small and deeply stained.

The large pyramidal cells of the infragranular region seem also thinned out. Similar slight degrees of thinning out of the cells are found in the supragranular pyramidal layers of the precentral region (upper portion right side); identical findings in lesser degree in the postcentral region and in larger degree of the superior parietal and inferior parietal regions. On the whole, the evidence of nerve cell loss or absence is distinct but slight. On the whole the supragranular layers appear to be more involved in this cell loss or absence than the infragranular layers. It is to be noted also that no important degree of satellitosis accompanies this cell loss, if we except the area examined from the right postcentral region.

A common finding in numerous areas is the presence of dislocated ganglion cells in the white matter. These were noted as frequent in right upper precentral, right postcentral, right inferior parietal, right superior frontal, and right prefrontal areas.

As for acute changes there was apparently a degree of chromatolysis in the larger cells in the frontal region, but not elsewhere.

e) Anatomical and Histological Summary.

Frontal and occipital cruciate asymmetry suggest inborn or very early acquired lesion. This case may well have been one of Dementia Praecox grafted upon a subnormal or moron condition and the microscopy is accordingly of interest. As in the previous case, (IV), so here there are frequent dislocated ganglion cells in the white matter. The gliosis and satellitosis of irregular distribution are con-

sistent enough with the hypothesis of acquired lesion. Nerve cell loss might be interpreted in either direction as due to fundamental absence or to early or late degeneration. In various places, the supragranular layers are subject to thinning out without any important degree of satellitosis (exception right post central region). Our best argument therefore for inborn lesion is the dislocated ganglion cells in the white matter, with the thinning out of cells in the supragranular layers as a not very strong secondary argument. Of course it has sometimes been held that satellitosis should be found alongside the cell loss in Dementia Praecox. Special studies in another series of cases, to be published in the Transactions of the Association of American Physicians for 1916, indicate, however, that cell loss and satellitosis do not necessarily proceed *pari passu* and that, in point of fact, in not infrequent instances, the cell loss proceeds independently of reaction. In some instances, it might be argued that the tissues passed through a phase of satellitosis followed by a phase in which nothing but cell loss can be demonstrated. An argument of this nature has been submitted in a paper published in the above mentioned Transactions for 1915. At any rate, it would probably be agreed by all that in Senile Dementia there are cases in which nerve cells slowly disappear without neuroglia reaction. The present case must therefore be used as another instance of the fundamental difficulty which attends a decision as to whether a case is one of primary or secondary amentia, even when a comparatively full anatomical and microscopic analysis is available.

SYNOPSIS IN FINDINGS OF CASE VI.

a) Clinical.

1. Physical Examination.—Born in 1887; died Oct. 19, 1913. Slightly microcephalic; tall and rather slight; death from pulmonary tuberculosis. Further data are given in the description of the autopsy, below, in which the following features are of interest from the point of view of the pathological anatomist. The number of scars of "tissue paper" appearance over extremities, back, and head, suggested syphilis. There were also numerous superficially palpable lymphnodes; mal-formed ears; prominent mastoid processes; high palatine arch; asymmetry of face, especially of nose and jaw; under developed hands and genitalia; redundant prepuce; absence of right vocal cord; hypoplastic aorta, and accessory spleens. No history of epilepsy.

2. Family History.—Unknown. There is some suspicion of syphilis in the father, but the suspicion has not been well established. Patient had been three years in almshouse at Tewksbury before admission to the Massachusetts School, May 27, 1893.

3. Personal Developmental History.—Is said to have had measles. At time of application, at 6 years of age, he is said to have just begun to talk, and as understanding a good deal of what was said to him. Patient is described as very restless and nervous; is usually rushing around; inclined to be destructive, especially of cloth; soils and wets himself several times a day and every night. He would spend his time destroying shirtsleeves and coatsleeves, unravelling his stockings, and the like.

4 and 5 and 6. School Progress and Examinations. Practical Knowledge.—Progress at the Massachusetts School was slight. Patient was placed in the training classes but did not advance much. He was able to do simple outdoor manual work. (He could help to clear land, use grubhoe, dig up stones, and the like, and was able to polish floors and carry bundles.) Was able to feed himself with a spoon although he spilled much of the food. Needed to be helped in dressing and undressing.

7. Economic Efficiency.—Nil.

8. Social History and Reactions.—Unable to speak words. Made curious squeaking attempts at speech if people that he liked were about him.

9. Moral Reactions.—If something patient did happened to annoy the caretakers, patient seemed to take pleasure in their annoyance. Patient had the typical idiotic grin when spoken to.

10. Psychological Tests.— Approximately 2. This case, by reason of his aphasia (compare absence of one vocal cord), yielded a poorer impression of his capacity than was perhaps justified. In some respects, patient appears to have been above the rank of idiocy and to fit into the lower grade of imbecility.

Waverley School History.— Patient's tuberculosis resisted outdoor treatment.

b) Autopsy.

Body.— That of a slenderly built emaciated white male 158 cm. in length. The *skin* is bluish gray, and abrasions occur over elbows, hands and shins, irregularly. There are also quantities of "tissue paper" scars over lower legs and back and scalp varying in size from 0.8–1.5 cm. in diameter. *Lymph nodes* palpable in neck and groins. *Rigor mortis* absent, no body heat. Decomposition bands in flanks.

The head is markedly out of proportion, being long and narrow (occipitomeatal 56 cm.) the *ears* flare and the measurement from superior portion of helix to lobule inclusive is 5.5 cm. $\times$ 4.0 cm. from tragus to lateral side of helix, with a wide and flat antitragus and a minute tragus. Mastoid processes unduly prominent. *Palatine arch* high, teeth in fair condition. *Nose* is deflected to right and the angle of the lower jaw on this side is markedly prominent, the line of the left being longer and the angle less noticeable. The *hands* appear larger than would be proportionate with the arms, and the finger nails are minute, measuring 0.6 cm. in height showing evidences of much nibbling and the eminences below the thumb are absent — giving the palmar surfaces a remarkably undeveloped appearance. Legs not notable. *Genitals*: The scrotum short and broad, extending in direction of but not reaching anal surface. Penis short and thick. Prepuce long, glands very red. No edema; a decubitus measuring 0.4 cm. over sacrum is fairly superficial.

Ventral section.— Panniculus nil. Muscles red, peritoneum shows post mortem change. Omentum contains no fat, transverse colon extends in a V-shape with apex downward into pelvic cavity. Stomach 14 cm., liver 8.0 cm. below costal margin. Spleen free; mesenteric lymph nodes remarkable in size and number, some measuring 3 cm. in length. Appendix 8.0 cm. in length — has a mesentery of its own. Prostate not enlarged, no free fluid in the cavity. Diaphragm arches to the 3d interspace on the right, the 4th on the left.

Thorax.— Mammary vessels not sclerosed, sternum measures 3.0 cm. on frontal aspect, 5.5 cm. on visceral. Bone marrow of sternum rich red, smears stained show excess of eosinophiles and few giant cells. No nucleated red cells.

Pleural cavities obliterated at apices, anterior edges of lungs overlap in median line: pericardium not thickened.

Heart.— (No weights taken), estimated 250 grams. No fat in epicardium. Myocardium greenish red (p. m.). Coronaries show no change. Section shows right auricle and ventricle filled with cruor clot. Myocardium elastic, not friable.

Measurements: T. V., 13.0 cm. P. V., 6.0 cm. L. V., 1.0 cm.

M. V., 10.0 cm. A. V., 6.5 cm. R. V., 0.4 cm.

Endocardium not remarkable. Some slight thickening in aortic cusps below corpus aurantii.

Lungs.— Not weighed. Over surface of left there are areas which show as slightly umbilicated centrally, red edges measuring 0.4 cm. Cut section shows a spongy parenchyma, with thickened bronchi in the lower portion and a gush of yellowish puriform material follows knife cut at apex. Stained smear shows tubercle bacilli in countless numbers.

Same process in right lung, possibly more extensive. Peribronchial lymph nodes not remarkable and showed no areas of infiltration on section.

Organs of the neck.— The tongue is heavily coated. The epiglottis is thick and yellowish and bathed in pus. The aryteno-epiglottidean folds are ragged on their free edges. From above superior and

inferior vocal cords appear unequal, and on section there are none on the right, being replaced by small white nodes which extend over the whole cavity of the larynx above the cord district. On the left a ventricle is the only mark by which a superior and inferior vocal cord may be inferred. *Thyroid* not notable. No thymus nor parathyroids seen. *Aorta* is remarkably narrow (3.5 cm. in circumference) and very elastic.

Abdomen.—*Spleen* not weighed. Estimated weight 100 grams. Somewhat autolysed, capsule not thickened. Pulp soft, trabeculae and malpighian bodies not notable. On the inferior edge two small accessory spleens hang, one is 0.2 cm., another 0.8 cm. in diameter.

Adrenals.—Remarkably small, not over 1.5 cm. at the widest part on cut section.

Kidneys.—Not weighed—estimated 200 grams. No perirenal fat; capsule stringy and non-adherent, cortex swells slightly over capsule, color of medulla and cortex homogeneous (from p. m. change). Pelves not notable.

Liver.—Not weighed—estimated 1500 grams. Capsule not thickened. Streaks of yellow occur on surface, organ friable but holds its own weight, inferior edges sharp. No stone in gall-bladder.

Pancreas.—Not examined.

Gastro-intestinal tract.—Not examined. Were deep greenish red from post-mortem change.

Genito-urinary tract.—Prostrate not enlarged. Bladder contains some heavy purulent material. Testis threads well.

Head.—Hair black and short; scalp adherent. Calvarium is well supplied with diploe but has curious inequalities in thickness; frontal measures 0.8–1.0 cm., temporal 0.2–0.8 cm. (in strikingly irregular alternations), occipital 0.9 cm. The dura is not adherent except along the superior longitudinal sinus, and is thickened only along the middle meningeal distribution and the convolutions are plainly seen through it. *Pia mater* is exceedingly thin and delicate, without edema; the twigs of the arterial capillaries are very brilliantly outlined. There are but two large veins on the vertex, these correspond very nearly to fissure of Rolando and are distended. The hemispheres are apparently equal in size with the exception of a bilobed occipital lobe on the right. There seems to be no cerebrospinal fluid. The *brain sags* on a board and tends to assume a nearly round mass. The *convolutional* pattern is simple and the sulci *shallow*, particularly is this so on the *right*, involving the motor and parietal lobule, and seeming to limit the frontal pole, the left parietal lobule having a more complex configuration and the frontal pole a greater extension. Smear from this portion shows striking loss of nerve cells; and infiltration of vessel walls with lymphocytes and polynuclear cells.

At the base.—The 2nd left temporal convolution at the tip has a yellow and denuded look under the pia and is somewhat firmer to the touch. Question of tubercle. Smear from this portion shows cellular detritus. No organisms.

The denuded area on the right temporal tip is artefact. The *basal vessels* are slightly hazy but no buds nor abnormal branching of arteries seen. The *pia* at base binds the 3rd and 4th nerves to the anterior perforated space. *Cerebellum* slightly softened, the olivary bodies are fairly firm as are the occipital tips. Remainder of brain (with exception noted) fairly normal in consistence. Pituitary pigmented on section. Ganglions negative. Petrous portion temporal bone thick. Left ear drum has a hole 0.3 cm. in diameter in its center with white and indurated edges, and smear shows tubercle bacilli. Right negative. Optic nerves show brilliant injection of retinal arteries with question of blurred outline of nerve head. There are irregularities in bone in the middle meningeal distribution. Brain weight, 1130 grams.

Cord.—Not notable.

Anatomical Diagnosis.

Emaciation.
 Abrasions over extremities.
 ?Syphilitic scars over extremities and back.
 Scars over head.
 Palpable lymphnodes (superficial).
 Dolichocephalic head.
 Malformed ears.
 Prominence of mastoid.
 Palatine arch high.
 Asymmetry face (nose and jaw).
 Nails nibbled below the mid line.
 Hands undeveloped.
 Redundant prepuce.
 Genitals undeveloped.
 Decubitus superficial (sacral).
 Gastropnoia.
 Splachnoplegia.
 Lymphnodes large and prominent (reversion?).
 Chronic fibrous pleuritis.
 Pulmonary tuberculosis.
 Slight chronic fibrous endocarditis (aortic valve).

Tuberculous epiglottitis.
 Tuberculous aryteno-epiglottidean folds.
 ?Aplasia vocal cords.
 ?Tuberculosis of vocal cords.
 Small aorta.
 Autolysis of spleen.
 Accessory spleens.
 Small adrenals.
 Slight acute parenchymatous nephritis.
 Cystitis.
 Calvarium unequal in thickness.
 Calvarium brittle.
 Focal chronic pachymeningitis.
 Slight anomaly right occipital tip.
 ?Hydrocephalus.
 Inequality of convolutional pattern, particularly right side.
 Slight basal leptomeningitis.
 Tuberculous ulcer left ear drum.
 Pigmentation of pituitary.
 ?Choked discs.
 Brain weight: 1130 grams.

c) Special Anatomical Description of Brain.

The brain is symmetrical; the frontal lobes small and pointed; the occipital lobes short, and their tips point away from the median line.

The pia is generally slightly thickened, with numerous arachnoid villi along the superior longitudinal fissure on both sides. The pial vessels are moderately injected, including the capillaries.

The convolutions throughout are broad, well-rounded, and there is a noticeable lack of complexity.

In the right frontal lobe, the first convolution is much narrower than the second or third; the two latter are not clearly defined, and are very scantily fissured. On the left there are apparently four longitudinal divisions, and each is somewhat more complex than on the right. The third left frontal is not remarkable.

The central convolutions are of good width, and well-rounded. The precentral is connected about midway its length with the base of the second frontal by a recurved annectant. The postcentral convolution is narrow at its upper extremity on both sides, and again at the junction of the middle and lower thirds on the right. The fissure of Rolando forms little less than a right angle with the superior longitudinal fissure. Its upper extremity cuts the superior margin on the left and on the right extends well over on the mesial surface. The lower extremity cuts the operculum on both sides and is lost in the Sylvian fissure.

The parietal lobes are marked by a very irregular pattern. The sulci are generally arranged in a transverse direction. The superior parietal lobules are broad; the right one somewhat more so than the left, and both present very few secondary fissures.

The sulcal pattern of the temporal lobes is rather irregular; on the right the superior gyrus is narrow

and loosely convoluted. The superior sulcus is distinct and complete. The second convolution is broad with very few fissures, and these are confined mainly to the posterior part of the gyrus. On the left the limiting sulci are indistinct, but on the whole the fissure-complex is less simple.

Of the mesial surfaces, the right is more complex; the cuneate lobule is larger and presents more fissures. The right calloso-marginal fissure is complete from its subrostral origin to the marginal extremity, while on the left it is interrupted several times by annectants. The corpus callosum is thin throughout its entire length.

The most evident peculiarity of the orbital surfaces is the difference in width of the gyri recti. The right is nearly twice as broad as the left, and extends beyond the median line to the extent that its mid-point corresponds in position to that of the optic chiasm.

The pyriform lobules are nearly uniform in size; the collateral fissure is continuous with the fissura rhinica on the right, but fails to join on the left. Altogether the left temporal lobe presents the appearance of better development than the right.

Frontal sections show no focal lesions. The cortex is of fair width, and the white matter comparatively small in amount. All the sulci in the temporal lobe are deep, and the gyri narrow, finger-like processes.

There is no enlargement of the ventricles, nor other anomaly apparent.

d) Microscopic Examination.

From the partial microscopic examination, the following is abstracted:

The findings in numerous areas yield a somewhat general picture. There is, as a rule, an increase of neuroglia cells in the white substance. Even the vessels are lined by an accumulation of neuroglia cells. There is a considerable satellitosis in all layers, including the plexiform layer, but there is no tendency to an excess of gliosis in the plexiform layer. There is a tendency to decrease of nerve cells so far as qualitative estimate can suffice in the diagnosis in most areas. The frontal areas show a smaller degree of scarcity of cells than numerous other areas. On the whole, the qualitative estimate of neuroglia cell increase rather indicates that the left side is more affected than the right (for example, left insula, left superior parietal, left pyriform lobule, left transverse temporal).

The findings of particular interest are as follows:—First, rod cells in the cortex of the right upper post central region, a region which also shows a moderate degree of cellular gliosis in the white matter; but this latter gliosis was characterized by the presence of a great many glia nuclei of unusual shape. The area showed very general thinning out of the cells in all layers, particularly at the summit of the gyrus. Frequently cells are found with an appearance of degeneration. Rod cells are also found in the right pyriform lobule.

Secondly; the finding of one large vessel in the right precentral region surrounded by a relatively heavy collection of lymphocytes; other vessels show numbers of green pigment-laden phagocytes. This area shows considerable satellitosis in all layers; the satellite cells are particularly noteworthy about the large pyramidal cells. There is an increase in neuroglia cells in the plexiform layer with a focal tendency. Of course in connection with a suspicion of brain syphilis, which we may consider proper to raise in connection with the lymphocytosis above noted, especial attention was given to the observation of other foci of lymphocytosis. Several other examples of infiltrated blood vessels were found in the frontal region and with a tendency to accretions in the vertical region.

e) Anatomical and Histological Summary.

This brain of simple construction (1130 grams) is comparatively symmetrical. Its corpus callosum is thinned throughout. The white matter of the centrum semi ovale is comparatively small in amount. It does not appear that the ventricles are enlarged. Microscopically once more we discover a marked

gliosis, with considerable satellitosis corresponding with a certain decrease of nerve cells, if we may judge qualitatively of such loss. On the whole the left side is slightly more affected than the right. We raised the hypothesis in Case IV as to old syphilis, basing our suggestion upon the presence of the effects of perivascular infiltration in posterior fissure of the spinal cord. If we follow the same line of argument in Case VI, we should call attention to the effects of lymphocytosis about a large vessel in the right pre-central region. The presence of rod cells in the cortex of the right upper post central region as well as in the right pyriform lobule may perhaps be regarded as evidence running somewhat in the same direction. These rod cells are characteristic of certain cases of General Paresis, although neuropathologists do not customarily make a diagnosis of brain syphilis upon the presence of rod cells. It may be that both the focal lymphocytosis and the occurrence of rod cells are based upon some other condition than syphilis, but at all events, the lesions are of an acquired nature and go to indicate the presence of at least a slight degree of active chronic, inflammatory processes. It is possible to think of tuberculosis as responsible for the lymphocytosis and it may be for the rod cell deposits, since this case showed widely distributed tuberculosis, pulmonary, epiglottis, vocal cords, left ear drum, etc. A review of the anatomical diagnoses in the case will show the presence of numerous stigmata.

SYNOPSIS OF FINDINGS IN CASE VII.

a) Clinical.

1. Physical Examination.— At 15 years of age, patient was five feet tall and weighed $97\frac{1}{2}$ pounds. She was born May 5, 1888, and died March 17, 1914. Patient is described as undersized, poorly nourished, anaemic, slightly deaf; as having a small cranium, with circumference of $19\frac{3}{4}$ inches, and cephalic index of 84. The face was asymmetrical, the eyes closely set, the teeth irregular, the palate high, and narrow arch. From the autopsy report, given in full below, the following features are culled: Absence of axillary hair, anomalous distribution of pubic hair, rudimentary left nipple, anomaly of toes, deflection of nose to left, dental ridges (mal-nutrition?), ovaries very large, anomaly of kidney; anomaly of sympathetic gangliated cord.

2. Family History.— Patient's father was born in New York City, of French extraction; the mother was born in England. The father was 37 years old at the birth of the child; the mother was 42, and had had four children before the birth of the present case. Three of the children had died before 1893: two girls, described as dying of marasmus, and one boy as dying of croup at the age of 5 years. It is stated that there was no deformity of body or mental deficiency in the other children. The mother is described as never having been very strong, and as subject to fainting fits. She is stated to have been in excellent health until the sudden death of the boy above mentioned, which death took place when she was 7 months pregnant with the present patient. The mother states that she fell off a small box 24 hours before delivery, and that the patient was born at 8 months. An aunt of the patient, the mother's oldest sister, is stated to have become paralyzed at the age of 24 years, and remained in this paralyzed condition until her death, at 42, of consumption.

3. Personal Developmental History.— The patient was carried on a pillow for a year, as she could not hold her head up. Patient began to walk at $3\frac{1}{2}$ years, and became very active. At 5 years, a few words, such as "ma," "pa," "money," "goodbye," "bad boy," were said. The patient is described as having tried very hard to say more words but as being unable to shape them. When desiring to attract attention to something, she would say "Bookit." At the age of 5, she had learned to use a spoon and fork, and kept her person clean. She was restless in sleep. There was a history of middle ear disease on both sides in early childhood. Patient was a mouth-breather, with large tonsils.

4 and 5. School Progress and Examinations.— Patient upon admission was unable to take the regular school work and was placed in the training classes; although kept in these classes for several

years, she made very little advance. She learned to march in step and could play very simple games. She could not be taught to match color and form.

6. Practical Knowledge.—When admitted to the school, the patient was untidy, but became thoroughly tidy after training. She was able to feed herself, and to dress and undress herself, although careless with the clothing and inclined to be destructive thereof. Patient learned to do simple work with the hands, such as cutting paper and cloth, but could not cut to a line.

7. Economic Efficiency.—Nil. Patient was able to do simple domestic work, such as dusting and rubbing the floor, and could make a bed with help.

8. Social History and Reactions.—Patient would often walk towards a person as if about to speak, and then draw back, repeating this action several times in succession. When excited, patient would jump up and down and scream, whether pleased or displeased, and would laugh and cry at the same time.

9. Moral Reactions.—Patient is described as having been of a good temper during her Waverley School life. She was fond of music and liked to look at picturebooks. Was apparently perfectly happy if given a doll or other toy. She was particular about food, liking goodies. She was always rather excitable and noisy, and interpretation of her emotion was difficult on account of the identity of reactions when pleased or displeased. Patient gave the impression of laughing and crying at the same time. Patient masturbated.

10. Psychological Tests.—Patient's mental age was 5 years.

Waverley School History.—Patient was admitted to the school, June 20, 1895, and after remaining a few months, was taken home by her mother. She was re-admitted in 1896, at the age of 8 years. She was very seldom sick at the school, dragged her feet, and stood and sat in a roundshouldered attitude. She would march in step if some one put hands on her shoulders in the proper way. Patient is described as running about in a lackadaisical manner, and as having a habit of skipping with one foot. She played relay races well, but was unable to see the point of some of the simple circle games. Patient was addicted to talking, and was more or less troublesome. She showed a number of peculiar movements; for example, she would roll and pick the front of her dress with her hands, and finish the process by holding a bunch of clothing in her left hand, passing her right hand in circles over her head. Another characteristic action was pointing her finger downward with arm extended, and repetition of "Yah, mamma, yah." Now and then she would shake her head and squint her eyes. Toward the close of life she had lost much weight and apparently also in height. Tuberculosis was made out in March, 1914, just before her death, involving the entire left lung and right apex.

b) Autopsy.

Autopsy.—Head, trunk and cord, Dr. M. M. Canavan.

Body.—That of a somewhat *emaciated*, slender white female, 146 cm. in length. Skin *waxy yellow white* in color. There is an *abrasion* over the right cheek, punctate in character, 2 cm. in diameter. No decubitus scars, edema, nor palpable lymph nodes. *Axillary hair* absent, *pubic hair*, yellow, grows in an *eliptoid* manner 4 cm. above the symphysis, and cylindrically over the labia majora. *Left nipple* appears rudimentary. *3d and 4th toes* on both feet much shorter than 1st or 2nd.

Abdomen distended and gives hollow note on percussion.

Pupils equal, 0.3 cm. Nose deflected slightly to left. *Upper teeth* slightly uneven, (suggestion of early nutrition disease) ridged, but no trace of uneven cutting edge. Orbital arches flattened, forehead measures 8 cm. in height above them and is a straight, not a curved line.

Ventral section.—*Panniculus* nil. *Muscles* in remarkable rigor. *Peritoneum* shining and grey. *Stomach* 20 cm., *Liver* 11 cm. below ensiform. *Spleen* large and free from adhesions. *Appendix* 5.5 cm. in length, somewhat injected, has a mesentery of its own. *Mesenteric lymph nodes* not enlarged. *Ad-*

hesions exist between lower inferior edge of liver and the transverse and ascending colon. Some free fluid — estimated 150 cc. thin and pale in color exists in peritoneal cavity.

Pelvis.— The uterus, 5 cm. in length, is in an anterior position; the right ovary measures $5 \times 2.5 \times 1.0$ cm.; the left ovary measures $3 \times 1.5 \times 1.0$ cm.

Diaphragm.— Reaches to the 5th interspace on right, to the 6th rib on left. Ribs are remarkably close together — hardly an intercostal space that was more than 0.5 cm. in width.

Thorax.— Lungs adhere to chest wall closely showing on the right a yellow puriform open space, and the left is evenly consolidated on palpation with recent fibrin at apex. Lungs not removed but cut in situ with the cavitation of right apex seen: it is extensive.

Heart.— Assumes circular form — epicardial fat scant — coronaries small — not sclerosed. Myocardium grey white. Endocardium not notable.

Valve measurements: T V, 10.0 cm. P V, 6.0 cm. L V, 1.0 cm.
M V, 9.0 " A V, 5.0 " R V, 0.5 "

The aortic valve is miniature in size of leaflets, and there is some sclerosis of the origins of the coronaries. The arch of the aorta is smooth — diameter of arch 2.0 cm.

Organs of neck.— Not removed.

Abdomen: Spleen.— $13 \times 9 \times 3$ cm. Markedly large; trabeculae distinct — pulp slightly watery and pale. No Malpighian bodies.

Adrenals.— None seen.

Kidneys.— Right much smaller than left; contains only three pyramids. Capsule thick, cortex pale and does not show injection. Pelvis very large — somewhat injected.

Liver.— Somewhat large. Capsule of Glisson is thickened, inferior edges fairly blunt. Color red-brown. Nothing of note on section. Gall-bladder wall white and edematous. No stones.

Pancreas.— Not examined.

Gastro-intestinal tract.— Stomach large and distended. Rugae not present. Intestines negative throughout.

Genito-urinary tract.— Ovaries contain pigmented scars — (has not menstruated for a year).

Retroperitoneal tissues.— Peripheral nerves negative. Sympathetic chain seems vastly broken up into fine threads.

Head.— *Hair* fine and abundant if short. Scalp pale, scanty in fat. *Temporal muscles* fairly well developed. Calvarium 0.3 cm. frontal, 0.1–0.3 cm. temporal, 0.4 cm. occipital; it is very dense and eburnated; no diploe. At the junction of the coronal and sagittal sutures the *dura* is markedly adherent (the brain herniating through small points of cut *dura* on forcible removal) and the *dura* is thickened from this central point to the area of middle meningeal distribution. Vertex is ball shaped and small. *Pia mater* is thin and delicate except over sulci and vertex where faint hazing appears.

Hemispheres equal but appear very shortened in the frontal portion as though the whole prefrontal area were missing. *Convolutions* are simple and shallow, running with no complexity to the longitudinal sinus. *Post rolandic gyri* simple in pattern. No inequalities on palpation. At the *base* the temporal lobes are exceedingly *plump*, and make the distance between their free edges and the frontal pole appear very short.

Basal arteries clear.

Optic and 3d nerves negative.

Gasserian ganglions negative.

Pituitary softened. Middle ears — left drum ruptured, right not seen.

Cerebellum, pons and cord negative.

Brain weight, 1270 gms.

Anatomical Diagnosis.

Emaciation.
 Abrasion of right cheek.
Absence of axillary hair.
Anomaly pubic hair.
Rudimentary left nipple.
Anomaly of toes.
 Distention of abdomen.
Nose deflected to left.
Malnutrition ridges on teeth.
Forehead high and flat.
 Splanchnoptosis.
 Slight injection of appendix.
 Chronic peri-colitis.
 Slight ascites.
Ovaries very large.
Ribs closely set.
 Chronic adhesive pleuritis.

Pulmonary tuberculosis, (advanced).
 Cloudy swelling of heart muscles.
 Right heart hypertrophy.
 Aortic stenosis.
Anomalous kidney.
 Chronic perihepatitis.
 Chronic cholecystitis.
 Anomalous sympathetic ganglionated cord.
 Calvarium dense.
 Chronic external adhesive pachymeningitis (focal).
 Chronic fibrous pachymeningitis — (middle meningeal).
 Slight chronic leptomeningitis sulcal and vertex.
Anomalous frontal poles (shortening).
Simplicity of convolutions.

c) Special Anatomical Description of Brain.

A more detailed description of the brain is as follows: — The brain is of fair size and suits the dolichocephalic type of skull. The dura mater was attached rather more firmly than usual to the pia mater and the brain by means of numerous pial vessels and their investments. There is no evidence of arteriosclerosis. The pia mater is everywhere slightly thickened and of a dull, cloudy appearance.

There is slight asymmetry of the two hemispheres; the right is shorter than the left, and the right occipital lobe points away from the median line. The convolutions are everywhere of fair width and usually well rounded and approximated.

In the frontal lobe, the dividing sulci are distinct. On both sides the first sulcus cuts across the precentral gyrus. The second frontal gyrus is broader than the first on both sides.

The central convolutions are quite narrow, the postcentral notably so.

The pattern of the parietal lobes is in general transverse in direction; the interparietal sulci are interrupted by an annectant between the postcentral gyrus and the superior parietal lobule on both sides. This leaves the ascending postcentral sulcus separate from the descending portion and the horizontal branch. On the right, at the junction of the descending and horizontal interparietal sulci, there is a distinct rosette formation. The size of the two parietal lobules, superior and inferior, is nearly the same on both sides.

The occipital surfaces are not notable except for the slight asymmetry already remarked upon.

On the base of the brain the orbital surface presents the usual triradiate sulcal pattern.

The collateral fissure on both sides is continuous with the fissura rhinica (Turner), thus separating the pyriform lobule entirely from the temporal lobe. The right pyriform lobule appears somewhat larger on the right than on the left.

The mesial surfaces present no remarkably anomalous cortical pattern. The corpus callosum is narrow in its horizontal portion as compared with the rostrum and splenium. There is no middle commissure.

The frontal sections show no pathological lesions. The cortex is everywhere of good width. There appears to be a rather smaller corona radiata than one usually finds. The basal gray matter is present in the usual amount.

The callosal angles of the lateral ventricles are rounded, but there is no definite enlargement of the ventricle cavity.

The cerebellum, pons and medulla are negative to gross examination.

d) Microscopic Examination.

The results of partial microscopic examination may be stated as follows:—

The most striking and general characteristic of the tissues is the generalized gliosis involving both an increase of cells and increase of fibrils. This gliosis affects the spinal cord as well as encephalic tissues. There is a suggestion of narrowing of the cortex cerebri throughout and a crowding together of the laminae. The blood vessels are everywhere prominent; this appearance is partly due to thickening but largely due to the frequency of perivascular gliosis.

One of the most important findings in the case is that of rod cells such as were found in case VI (although in case VI there are a few foci of perivascular infiltrations). The variations in the different areas examined are quantitative rather than qualitative. The rod cells are found most frequently in the precentral, post central, calcarine and temporal areas.

One area, the right transverse temporal, shows a canalized thrombus in a small vessel, with a vacuole or approach to a small glia-lined cyst nearby. There is a small acute hemorrhage under the pia mater of the right angular gyrus. The right superior frontal region appears to show a larger degree of cell atrophy (with numerous shadow cells) than is found elsewhere.

e) Anatomical and Histological Summary.

This brain of an imbecile weighed 1270 grams, is fairly complex in construction, of fair size, with slight asymmetry and a narrow corpus callosum as to its horizontal part. There is apparently no definite enlargement of the ventricular cavity. Microscopically there is a generalized gliosis which involves not only the encephalic tissues but the spinal cord. The most important finding in the case is that of rod cells, as in Case VI, but the perivascular infiltrations of Case VI are not present in Case VII. The rod cells are more widely distributed in the present case.

A canalized thrombus in one region may be regarded as another sign of acquired lesion; but as to the date of this lesion nothing can be said. Note is made below of the fact that the mental age of this patient, set in a general way at 5 years, was regarded in some respects as over-estimated since in a number of directions the patient appeared to verge upon idiocy.

SYNOPSIS OF FINDINGS OF CASE VIII.

a) Clinical.

This case will probably be reported *in extenso* elsewhere in collaboration with Dr. G. B. Magrath, Medical Examiner of Suffolk County, who performed the autopsy in pursuance of official duty. We have acted as his deputies in executing our brain studies.

The case belongs in Dr. Magrath's series of "judicial homicides" having been electrocuted for murder. A number of more or less competent persons regarded the subject as "defective." Further details are reserved for the present. The brain is presented as a foil to the others of the series. If "feeble-mindedness" is a term roughly equivalent to inability of self-support, then this subject should perhaps not be regarded as feeble-minded. If "defect" may be used to include lack of "normal inhibition," then probably this case might classify as defective.

The subject was physically well developed, had been a "nervous" and "bad" boy, could read and write, had marked practical ability in certain ways, earned a sort of living, was criminalistic, had an

ungovernable temper and was easily overcome by alcohol. There is no means of knowing what his mental "grade" would have been; we have placed it at 12 plus.

b) Autopsy.

Gross findings reserved.

c) Special Anatomical Description of Brain.

There is slight asymmetry of the occipital lobes; the right is thin and points away from the median line, while the left does not.

The pia is thickened and white over the vertex, and the vessels are considerably injected; particularly the larger ones.

The convolutional pattern is noticeable in that the direction of the gyri is a transverse rather than an antero-posterior one. (This has been noted as a developmental anomaly in mental defectives.) The gyri are well rounded and of fair width, but their summits are not approximated. The markings are of medium complexity in the anterior region, but less so in the part adjacent to the central lobule.

In the central region the precentral gyrus is unusually wide in its upper third; the postcentral is very narrow in its upper third, but becomes of average width below. The upper extremity of the fissure of Rolando extends barely to the border of the superior longitudinal fissure and approaches it at an acute angle. The lower extremity does not cut the operculum.

The parietal lobes are well developed with distinct markings. On the right the interparietal sulcus is typical; the postcentral portion is continuous and is intercepted at its middle point by the horizontal limb. On the left the ascending postcentral is separated by a narrow annectant from the descending and horizontal branches, which are continuous. The convolutions of the inferior parietal lobule are broader and less complex than those of the superior parietal. This lobule is marked both by longitudinal and transverse fissures. The entire lobe is characterized by the lack of approximation of the walls of the interparietal fissure and of the convolutions of the superior lobule.

The occipital lobe is not remarkable; the convolutions are of good width, fairly well rounded, their walls well approximated, and of complex arrangement.

On the orbital surface the convolutional pattern is not markedly different from that ordinarily seen.

The pyriform lobules are noticeably asymmetrical; the right is considerably wider than the left, and this is true of the entire hippocampal lobule. The rhinal fissure (Turner) is well marked. The convolutions of the extreme tip of the right occipital lobe are narrow and irregularly arranged. The sulcal pattern over the entire base of the brain is unusually symmetrical.

The main differences of configuration on the mesial surface are the presence on the left of two sulci parallel with the callosum, while on the right there is but one. On the left, the parieto-occipital fissure is wide open, disclosing an otherwise hidden convolution which dips down from the superior surface of the superior parietal lobule and turning back upon itself, joins posteriorly with the superior occipital gyrus. The sulcal complex on the right precuneus is triradiate, while that on the left is made up of four branches. The former has one fissure extending upward toward the superior margin, and two downward and outward; on the left two point upward and outward, and two downward and outward.

The callosum is of good extent and thickness except in the posterior third of the horizontal portion where there is moderate narrowing. The middle commissure is present.

The frontal sections illustrate well the lack of complete longitudinal sulci in the frontal lobes; these can be easily identified only in the most anterior portion.

There is nothing remarkable in the appearance of the cortex, nor of the basal nuclei.

The ventricles are not dilated.

d) Microscopic Examination.

The results of a partial microscopic examination may be abstracted as follows: —

Gliosis is noted in numerous areas but was rarely of marked degree and often showed a tendency to focalization. Subpial gliosis is noted in the paracentral, postcentral (more marked left), temporal pyriform, cornu ammonis, left prefrontal, right insula, and Broca areas. This subpial gliosis is, as a rule, more marked at the bottoms of the sulci or along their sides than at the tops of the gyri. It is not often of marked degree.

Perivascular gliosis is especially noted in the right precentral, right middle temporal, superior frontal, middle frontal prefrontal and Broca areas.

Satellitosis is especially noted in the paracentral, right postcentral, left cornu ammonis, superior frontal, middle frontal, prefrontal and insula regions, and to a lesser extent in several other regions. Gliosis of the white matter is especially noted in the right middle temporal, middle frontal, prefrontal, insula and Broca areas, as well as in areas noted above, showing perivascular gliosis in the white matter.

Dislocated ganglion cells are noted especially in the white matter of the right precentral area and appear in general to be rare in this case.

The only instance of exudate consists in infiltration of the space about the small blood vessels in the left prefrontal region, where cells are found highly suggestive of plasma cells. Evidence of recent cell destruction, completed or in process, are few but distinct. The notes show cells with poorly staining nuclei and surrounded at their bases by satellite cells in both paracentral regions. Satellitosis was also found in the postcentral region in considerable degree.

In the right transverse temporal gyrus, cells are occasionally found of the small pyramidal type, having a clear ring outside the nucleus, suggesting that the chromatic substance had undergone a solvent process in the cell interior. Shadow cells are found in the pyriform lobules and are here associated with cells showing the clear perinuclear rings just mentioned as found in the transverse temporal region. Other areas show occasional cell changes of the same general nature.

The total brain sections in this case show deep sulci, possibly more so on the left side; the cortex roughly averages 3 mm. in depth at the summits of the gyri and is thinner elsewhere. The white matter appears to preserve a fair proportion to the cortex. There seems to be notably less white matter on the left side of the brain. The larger vessels in the white matter are surrounded by large pigment-laden cells.

Especially interesting was a slight degree of heterotopia of the gray matter consisting in four small areas below the cortex on the superior surface of the temporal lobe. The blood vessels of the temporal lobe show dilatation of their perivascular spaces with a few large pigmented cells. The ventricles are not dilated; the corpus callosum is of proper thickness, approximately 8 mm.

It does not appear that there is any evidence of thinning out of the nerve fibers. The suggestion that the left hemisphere has comparatively less white matter than the right is based upon observations both in the anterior and posterior part of the brain.

e) Anatomical and Histological Summary.

This brain (1340 grams) in a physically healthy, executed subject, is found to show a number of minor asymmetries, such as the transverse direction of convolitional pattern in many regions. The summits of the gyri are not always approximated. The corpus callosum is of proper size except for a moderate narrowing in the posterior third of the horizontal portion, in which latter connection may be mentioned that the parietal lobules are especially characterized by the lack of approximation of the walls of the gyri.

Microscopically there is a certain tendency to slight gliosis of a focalized nature. This gliosis is more, as a rule, at the bottoms of the sulci where there is normally more fiber-producing tissue. Both the fibrillar gliosis and satellitosis are fairly widespread in cortex and white matter and there is a certain amount of perivascular gliosis. The argument for fundamental hypoplastic changes may perhaps best be based upon dislocated ganglion cells in the white matter of the right precentral area, but the rarity of such cells is conspicuous and it would not seem well to make a diagnosis of hypoplasia or heterotopia upon this single finding. Again, the single focus of perivascular infiltration by cells resembling plasma cells in the left prefrontal region is perhaps but slight evidence on which to ground the hypothesis of brain changes of an important nature in this executed criminal. A vast deal of comparative work in "normal" cases must yet be done before a decision can be rendered on such a point.

That the case had inborn peculiarities may be argued from the stigma of heterotopia in the temporal lobe and perhaps somewhat upon the deep sulci, possibly deeper on the left side, which the total brain section demonstrated. The suggestion that there is somewhat less white matter on the left side of the brain than on the right may also be entertained as indicative of inborn peculiarity. There is in the case apparently no evidence of thinning out of the nerve fibers.

An analysis of this case in comparison with others in a series of executed homicides will be profitable.

SYNOPSIS OF FINDINGS OF CASE IX.

a) Clinical.

1. Physical Examination.—Patient was born August 3, 1875; admitted May 17, 1883; died August 30, 1914. The patient at autopsy showed an enlarged thyroid and cystic kidneys, but had no other anomalies. The stomach was dilated. He is described as having been a strong and healthy subject.

Voice hoarse, words pronounced in a staccato manner. Patient a little deaf; at all events, later in life.

2. Family History.—Father and mother are said to have been strong and healthy; the father 30, and the mother 32 years old at the time of the birth of this child. There had been four children before the birth of the patient, and one thereafter. One of the children had died of "summer complaint." It is stated that there are no evidences of deformity or mental deficiency in the other children. The mother died in childbirth, at 37 years. The family was American.

3. Personal Developmental History.—Patient began to walk at 2 years, and to say a few words at 5 years. His mental deficiency was noticed at 3 years of age, when it appeared that he was not trying to talk. At 8 years, when patient was admitted to the school at South Boston, he could not talk plainly and had untidy habits. He had not learned to read or write.

4 and 5. School Progress and Examinations.—Patient upon admission was placed in the training classes, and learned a good deal. He learned to do simple outdoor work on the farm, such as grubbing, picking up stones, and the like. In his 25th year, he was transferred to the Colony, where he developed markedly and was regarded as fairly intelligent and industrious. His strength and abundance of health permitted him to help the blacksmith; he could measure and saw off wood, and use a plane and sandpaper. He would keep the blacksmith's tools lined up for him, and assist in shoeing oxen.

6. Practical Knowledge.—His practical knowledge is indicated by the remarks under *School Progress* (see above). Although he could use the plane, saw, and chisel well, his sense of measurement was so deficient that, for instance, he could not tell the difference between 5 and 9 inches. However, if given a piece of board 4 inches wide, patient could go and get another of the same width. If the car-

penter marked with pencil a line to which patient was to plane on a piece of board, he could plane to that mark. Practically speaking, he seemed to be better than his Binet age would indicate.

7. **Economic Efficiency.**— See above.

8. **Social History and Reactions.**— Patient was much beloved by the caretakers. He was kind-hearted and anxious to please, and after his fashion had a very keen sense of humor, apparently understanding much more than he was able to express; used nouns, active verbs, and a few descriptive words, but never learning to put sentences together.

9. **Moral Reactions.**— Patient belonged in the amiable and "altruistic" group.

10. **Psychological Tests.**— Binet tests performed in 1914 show the patient to be of a mental age of 7.

Waverley School History.— The advance of this patient under supervision and the conditions of the school, and later of the colony, was considerable, as above indicated. As the patient grew older, he was given more difficult work, which he was able to perform with fair satisfaction; this progress was of a degree rather unusual in the feeble-minded. Patient was fond of music and of humming melodies, although he did not pronounce the words.

The patient was killed by being run down by an automobile while being taken off the grounds with a group of boys on an outing. He had been in general regarded as able to take care of himself and keep out of the way of traffic, although the conditions of state roads may have been more complex than ordinary for him. There was a certain error of judgment on the part of the automobile driver.

b) Autopsy.

Body of a well built and nourished white male 5 ft., 10 in. in length (177.8 cm.). *Skin* rosy grey but shows marked number of recent abrasions as follow:

Right parietal boss is prominent and exhibits a superficial cut 5 cm. in length by 0.5 cm. in width. Hair shaved on this side. *Right mid scapular line* shows abrasions 3×0.5 cm. *Right elbow* 3 small ones 3×2 cm. in extent. *Right lumbar region* just above crest of ilium 5.0 cm. $\times$ 1 cm. *Right popliteal space* 5×1 cm. *Right knee* inner aspect 3×0.8 cm. *Right mid shin* anterior aspect 3×2 cm. *Left, below crest of ilium* (gleutial side) an abrasion 12 cm. in length $\times$ 2 cm. wide. *Left thigh* lower third outer aspect is another 3×1 cm. *Left knee* inner aspect 2×2 cm. *Bruises, right knee, right shin, right ankle* (inner and outer aspects), *left ankle* slight bruising 7×7 cm.

Rigor mortis present, in legs — not in arms. No palpable lymph nodes. *Pupils* 0.5 cm. equal. Slight amount regurgitated material left face and neck.

Ventral Section.— Fat over abdomen measures $3\frac{1}{2}$ cm. Over thorax $\frac{1}{2}$ cm. Muscles red. Peritoneum is bluish red in lower anterior portion and there is blood between the fascia of the rectii muscles and the peritoneum as high as 10 cm. above the symphysis. There is *free blood* in the peritoneal cavity, estimated quantity 25–40 cc. The *intestines* are dilated, the *liver* is above costal margin and lightly stained with blood. *Stomach* dilated and 10 cm. in length. *Spleen* free. *Mesenteric lymph nodes* not palpable. *Hemorrhages* exist in the layers of the mesentery. *Diaphragm* arches to the 4th rib in right to 4th on left.

Thorax.— Muscles removed from anterior thoracic wall shows much hemorrhage into the muscles between the *left clavicle* and sternum between 1st and 2nd rib. On the right between clavicle and first and between 1st and 2nd ribs, there is a separation of the clavicle and the sternum *on the left* by hemorrhagic and edematous muscle and the first rib is broken approximately 1 cm. from the junction of it to sternum. *On the right* the upper end of the chest wall sinks in a little more than the left and a fracture is present on right first rib 8 cm. from mid sternal line and the 2nd is also fractured somewhat latterly to the first. Anterior portion right chest presents subperiosteal fractures of the 7th, 8th, 9th and 10th ribs with marked hemorrhage into parietal pleura. None on the left.

Upon removal of the lungs, there is also seen marked hemorrhage in posterior surface of right pleura and underneath it the 3rd, 4th, 5th, 6th, 7th, 8th ribs are fractured about 1–3 cm. from vertebrae and 10 cm. from vertebrae the 10th and 11th ribs are also. Marked hemorrhage into posterior mediastinal tissue, on either side, also retroperitoneally in abdomen. *Heart* weight $12\frac{1}{2}$ oz. (354 grams). Epicardial fat scant, muscle somewhat pale but firm. Valves negative. Endocardium smooth.

Measurements: T.V. $5\frac{3}{4}$ in. (14 cm.) P.V. $3\frac{1}{4}$ in. (8.25 cm.) L.V. $\frac{1}{2}$ in. (1.2 cm.).

M.V. $4\frac{3}{4}$ in. (12.0 cm.) A.V. $3\frac{1}{2}$ in. (8.8 cm.) R.V. $\frac{1}{8}$ in. (0.3 cm.).

Lungs.—Right $22\frac{1}{2}$ oz. (638 grams). Left $20\frac{1}{2}$ oz. (567 grams.). Nothing of note except old adhesions left apex and recent congestion of both lungs.

Organs of the Neck.—Thyroid markedly enlarged and protuberant; weighs $3\frac{1}{2}$ oz. (99 gms.). Normal on section except right lobe which is very much congested. *Tongue, larynx, trachea, esophagus* negative.

Abdomen.—*Spleen* $6\frac{1}{2}$ oz. (184 gms.). Nothing of note. Capsule not thick, pulp fairly soft, trabeculae prominent. *Adrenals* small; otherwise negative.

Kidneys $9\frac{1}{2}$ oz. (269 gms.). One kidney fairly normal; the other, the left, is studded with smooth, firm glistening bodies 0.2 cm. to 0.3 cm. in diameters. Capsule peels with difficulty. Cortex reduced and replaced by these cysts which appear colloidal; the cortex is also injected. *Pelves* negative.

Liver $58\frac{1}{2}$ oz. (1610 gms.). Nothing of note. No gall stones.

Pancreas. Very white instead of yellow and a curious softness unlike the usual gland. No hemorrhages.

Gastro-Intestinal Tract.—Negative throughout. Remains of hastily eaten vegetables in stomach. Well distended, few rugae.

Genito-Urinary Tract.—Bladder external wall very hemorrhagic; inner wall clear. Clear fluid in bladder. *Prostate* not examined. *Testes* thread well.

Retroperitoneal Tissues.—Aorta and branches smooth and elastic. No lymph nodes seen. Marked hemorrhages into the retroperitoneal tissues.

Head.—Hair brown, cropped on right. No marks on inner side of scalp. Calvarium thick; frontal $\frac{1}{4}$ in. (0.6 cm.); temporal $\frac{1}{8}$ in. (0.3 cm.); occipital $\frac{3}{8}$ in. (0.9 cm.). Not much diplöe. Dura thickened but not adherent. Pia thin and delicate. Convolutions simple and wide, in every location. General feeling of "normalness" to fingers, slightly putty-like at base. No atrophy nor gliosis.

At the base, a slight amount of meningitis bends the optics, the circle of Willis and the 3rd nerve together. Tips of olfactory bulbs adherent to skull. Optic nerves slightly edematous but smaller than normal. Ganglions and pituitary negative. Ears and discs not examined.

Brain wt. 54 oz. (1622 grams.). Cord not removed.

Anatomical Diagnosis.

Well nourished.
Abrasions, head, trunk, extremities.
Bruises, extremities.
Subperitoneal hemorrhages.
Free blood in peritoneal cavity.
Mesenteric hemorrhages.
Intercostal hemorrhage.
Fractures ribs, right anterior 2nd, 7th, 8th, 9th, 10th.
Fractures ribs, right posterior 3rd, 4th, 5th, 6th, 7th, 8th, 10th, and 11th.

Fractures ribs, left, 1st rib.
Slight adhesive pleuritis.
Pulmonary congestion.
Enlarged thyroid.
Cystic kidneys.
Hemorrhagic cystitis (bladder wall).
Retroperitoneal hemorrhages.
Normal brain.
Slight edema optic nerves.
Brain weight 1622 gms.
(Tigges' formula 1424.)

c) Special Anatomical Description of Brain.

The brain of this case is large and suits the dolichocephalic skull. The orbital frontal angle made between the basal and lateral aspects of the frontal lobe is unusually prominent throughout. The occipital lobes exhibit a slight degree of asymmetry; the inferior parietal lobules are slightly more prominent than the surrounding tissues.

The intermediate precentral area has the "coronal" type of construction. The gyri are in general of good width and of fairly simple pattern. The summits of the gyri do not, as a rule, well approximate; in many places the summits do not lie in the same plane; this gives the brain surface a motley, irregular configuration, somewhat suggestive of foothills.

The corpus callosum is of a good depth except in the posterior third where it is comparatively narrow. There appears to be no middle commissure.

The pia mater is slightly thickened and hazy throughout and the arachnoidal villi are moderately well developed along the vertex of the superior longitudinal fissure. There are small pinpoint white nodules in the pia mater, especially over the sulci, chiefly in the region of the superior parietal lobule.

d) Microscopic Examination.

An abstract of the most important findings yet made is as follows: —

Subpial gliosis is nowhere in evidence. Gliosis of the white matter is found in a number of areas, precentral, postcentral, temporal, occipital, frontal, but is nowhere marked. There is no perivascular gliosis except for a slight amount in the section over the right prefrontal region. Satellitosis is nowhere noted.

The fiber stains show no notable variation from the normal (as judged by drawings in Campbell's "Localization of Cerebral Function"), except that a section from the right superior temporal gyrus shows some diffuse thinning of radiary fibers; but even this appearance may possibly be regarded as artificial. We have not regarded the presence of knoblike enlargements along the course of the fibers as of pathological significance.

As might be expected from the nerve fiber and glia appearances, the nerve cell pictures are not far from normal upon qualitative examination. There are, however, a number of stratigraphical appearances consistent with the hypothesis of arrest of development. Thus the supragranular layers of the precentral, postcentral and frontal regions are not definitely laminated.

The evidences of cell loss or numerical hypoplasia in the supragranular layers is, as a rule, confined to the lower portions of these layers. The granular layers are, as a rule, distinct, where they are normally distinct and in general of a normal appearance, unless we regard the cells as slightly thinned out in some places (right upper postcentral, right superior parietal).

The infragranular layers show apparent scarcity of cells in a number of regions, for example, precentral, postcentral, occipital, superior parietal.

The above description suggests a certain irregularity in the distribution of the hypoplasia. The area which more than any other shows architectural disturbance appears to be illustrated by a section from the right superior frontal region. The cortex here shows a narrow plexiform layer but underneath a complete absence of distinct lamination. The granular layer, for example, is nowhere distinct. The scarcity of cells seems to be a definite one and of a convincing degree. The cells that persist show a variety of staining reaction — many of the cells have a pale and finely granular protoplasm. On the other hand a good many cells contain perfectly staining Nissl granulations; there is a moderate degree of phagocytosis in the perivascular spaces in this area and, as above noted, a slight cellular gliosis in the white matter.

The sections stained for the demonstration of neuroglia fibrils fail to show any convincing increase thereof. The Weigert myelin sheath stains are negative as to nerve fiber change. The prefrontal cortex on the right side shows an even more marked scarcity of cells.

A type of problem is brought up, for example, by a section from the right upper postcentral region. Here there is a number of giant pyramidal cells suggesting that there might have been an error in the labelling of the section and that it had been mistaken for a section of precentral cortex. On the other hand, the supragranular layer in the cortex here sectioned is much more like the postcentral cortex and there seems to be no reason for supposing that in this case there was a mislabelling of sections.

A section from the right intermediate postcentral gyrus shows an unusual tendency to the grouping or bunching of nerve cells in compact nests containing 2-3-4 cells; sometimes the nerve cells are found overlying each other slightly.

In a section from the right superior occipital area, a number of dislocated ganglion cells are found a good way into the white matter. One of these dislocated cells was found with two nuclei. On the whole, however, in this case there are not many instances of dislocated ganglion cells in the white matter.

e) **Anatomical and Histological Summary.**

The brain of this imbecile of 39 years weighed 1622 grams, as is perhaps consistent with his belonging to what is sometimes termed, for practical purposes, the able-bodied or colonial type of feeble-minded. The corpus callosum is of good depth except for a narrow place in the posterior third. Microscopically we failed to secure evidence of gliosis in the subpial region nor marked evidence of gliosis in any locus. In particular, there was no evidence of satellitosis. Accordingly we may regard this case as without evidence of active phenomena, whether inflammatory, sclerotic, neuronophagic. There was one region in which there was a moderate degree of phagocytosis in the perivascular spaces. This region, the right superior frontal, was interestingly enough the region in which occurred the most marked architectural disturbance with a complete absence of distinct lamination.

This brain, accordingly, shows one of the purest examples yet seen of uncomplicated irregular arrest of development with stratigraphical, architectural alterations (right superior frontal, right upper postcentral, dislocated ganglion cells, right superior occipital) without complications of acquired disease.

SYNOPSIS OF FINDINGS OF CASE X.

a) **Clinical.**

1. Physical Examination.— Patient was born Oct. 3, 1876; admitted Feb. 17, 1887; died of pellagra, Nov. 17, 1914. Patient was slenderly built, and well nourished up to two years before his death, when pellagra set in. From the autopsy findings, some points concerning the physique of the patient may be taken. The nose was saddleshaped and the head narrow, dolichocephalic, eyes small, ears irregular with adherent lobules, prominent abdomen. The patient was never very strong and had a poor circulation so that he could be kept out of doors only in the warm weather.

2. Family History.— The father was a native American, 25 years of age at the birth of the child. The mother was born in Canada, and was 20 years of age at the birth of the child. She had had one child before the birth of the patient, and has had two since without evidence of physical deformity or mental deficiency. There is no history of mental disorder in the family. There was nothing unusual about the pregnancy or delivery.

3. Personal Developmental History.— The patient began to walk at two years; was not able to

talk, and is described as having been of a passionate temper. Late in talking; could say very few words at time of admission.

4 and 5. School Progress and Examinations.—There was improvement physically when the patient was placed in the outdoor classes.

6 and 7. Practical Knowledge and Efficiency.—Patient could carry stones, use a grubhoe, carry bundles, and rub floors.

8. Social History and Reactions.—Patient had a quick temper and would attack people who got in his way. On account of his tendency to cruelty to weaker subjects, he was kept with the older boys. He could say a few words, could not talk in sentences, but used profane and obscene phrases.

9. Moral Reactions.—Patient was more or less irritable, violent, inclined to be noisy, and as above stated would attack persons. Masturbation.

10. Psychological Tests.—Binet test made in 1914 showed the patient to be 2.4 years of mental age.

Waverley School History.—The patient grew more and more troublesome as he grew older, becoming noisy and more untidy. In his thirty-seventh year, the patient began to lose weight and became emaciated, and developed a peculiar skin eruption on the back of the neck and extensor surfaces of the hands. The eruption was symmetrical and was regarded as pellagra. This eruption healed with stimulating ointments, and the patient grew physically somewhat better. Later the eruption returned and, despite outdoors treatment, a decubitus developed, finally covering a portion as large as a dinner plate, with great destruction of tissue and offensive odor.

b) Autopsy.

Body of a slenderly built and poorly developed white male, 144 cm. in length. *Skin* is yellowish grey except over the face where it is diffusely pigmented (freckles) and over the exposed portions of the head where the hair sparsely grows (frontotemporal region): here it is a deep brown color with crackled lines alternating with patches of white. This condition is especially marked in the back of the neck extending as far backward as the 7th cervical vertebra where it is abruptly replaced by normal appearing skin. The *hands* are brown, especially over the knuckles where the skin is scaling, so much that it may be lifted from the pale true skin. This pigment is apparent on the hands up to the wrists and extending in a gauntlet shape 4 cm. above the wrist where it also fades from this diffuse and dense color into isolated pigmentation (freckles) that gradually become less until the axillary region is reached. There are some scattered freckles over the chest and abdomen and upper thighs.

Over the mid-shin region of both legs there are brawny brown areas measuring 8×4 cm. and 12×6 cm. There is a bruise measuring 3×2 cm. over the anterior surface of the right mid-thigh; another 4 cm. above left patella.

There are *gangrenous areas* on the skin over the posterior portion of the right shoulder, measuring 4×3 cm., over the right trochanter major measuring 12×10 cm. This is markedly sloughing and extends deeply into the muscular substance. Probing this muscular substance, a soft, mushy, non-resisting tissue appears in the place of the normal firm resisting muscular tissue.

A similar area over the left trochanter major measures 8×6 cm. over the left shoulder, another measures 4×5 . Also in the inner surface of each knee similar areas vary in size from 3×4 cm. — 1×1 cm. and 0.8×1 cm. in diameter.

A few scattered hairs over upper sternal region. Pubic hair more or less triangular in shape, grows in a straight line to the ensiform; hair also grows on inner thighs, also legs and forearms. There is scanty evidence of hair over face.

Nose slightly saddle shape with broad bridge and small alae.

The *pupils* are dilated and unequal; the right measures 0.7 cm., the left 0.6 cm. The lips show

sordes. The *teeth* are poor and there is a bloody fluid between them. (Some report of sore mouth previous to death).

Ventral section.—Fat over abdomen 1.0 cm., over thorax, 0.5 cm. Muscles pinkish. Peritoneum is grey.

Liver.—6 cm. *Stomach* 8 cm. *Transverse colon* 15 cm. below the ensiform.

The *omentum* is very rich in fat and covers intestines completely. *Intestines* are injected and slippery to the touch. The appendix measures approximately 4 cm. and is large at its distal end. The *bladder* is not distended. There is a little free fluid in the abdominal cavity. The *mesenteric lymph nodes* not enlarged. Spleen exceedingly large. *Diaphragm* arches to the third rib on the right and to the 5th on the left.

Thorax.—Lungs adherent to the chest wall in the mid-anterior portion. There is no free fluid in the *pleuric cavities*. Pericardial sac contains slight traces of fluid.

Heart.—Assumes a circular shape on being removed. It is very flabby and it would be difficult to tell which were the left side on inspection. The descending branch of the left coronary is smooth and delicate, as is the right coronary. *Myocardium* is pale and flabby and not friable. Valves are negative except the aortic which shows a sessile red adherent body clinging to the middle of the posterior cusp measuring approximately 0.8×0.6 cm. No other vegetations.

Approximate measurements: TV 8.0 cm. PV 5.0 cm. LV 0.9 cm.
MV 9.0 cm. AV 8.0 cm. RV 0.3 cm.

The intima of the *aorta* is very red and firm.

Lungs.—No weights taken. Right lung has but two lobes. The upper is normal; the lower is injected on lateral surface and on section there is reddening of the lung tissue superficially. *Bronchi* are covered by reddish thin fluid. Left lung is markedly congested in the posterior portion. Pleura has been torn on removal of lung but there is no raised area around the bronchi at that point. There is a small area not more than 3 cm. in diameter where the bronchi have induration about them in the central portion of the lower lobe. *Bronchi* reddened throughout.

Organs of the Neck.—Not removed.

Abdomen.—*Spleen*: Markedly large; measures approximately $14 \times 10 \times 4$ cm. *Capsule* not thickened but dark areas (?). Hemorrhages show through the capsule. On section the pulp is very soft, scrapes heavily and the malpighian bodies faintly discernible. The *pulp* swells above the cortex on section and there are greyish pink wedge shaped areas with their bases toward the capsule that show red external borders. *Trabeculae* indistinct.

Adrenals.—Small. The cortices are both pale yellow edematous and fade into a deeper brown at irregular intervals. The central portion is brown and there is no softening.

Kidneys.—Fairly well supplied with fat. Capsule strips easily but is opaque. The cortex measures 0.6 cm., is brilliantly and uniformly injected and red points dot the intervacular injections. At one point there is a bright yellow-grey wedge shaped body occupying the cortex for a space of 1.5×0.6 cm. The *pyramids* are poorly differentiated, look yellow in their centers. *Pelves* markedly congested. The other kidney not so injected but swells over capsule on section and on stripping the capsule the kidney surface is pulled away at two points. No *cysts* seen.

Liver.—Measures approximately 20×18 cm. The surface is mottled yellow and red. Cut surface swells slightly over the capsule. Color of the liver on section is not remarkable; shows lobules well marked but no congestion. The *gall bladder* very small; contains a few cc. of turbid yellow fluid.

Pancreas.—Not examined.

Gastro-Intestinal Tract.—Stomach dilated. Swells somewhat; edematous; no rugae. Mucous wall drips grey fluid and the wall has a granular and somewhat injected appearance. The same is true of the lower tract but no ulcers of hemorrhagic state of the intestines seen, with the exception of focal areas of injection in the upper third of the descending colon. The content of the entire intestinal tract and particularly the colon is fluid brown yellow.

Genito-Urinary Tract.—Bladder negative. Prostate not enlarged. Testes not examined.

Retro-Peritoneal Tissues.—The lymph nodes are not present. There are (?) hemo-lymph nodes along the aorta. The sympathetic ganglia small. The aorta is small in calibre and thin walled. The peripheral nerves negative.

Head.—The cranium is narrow, measures 52 cm. in circumference and the hair grows scantily over the entire scalp. The scalp is adherent and inelastic. Calvarium is dense and measures, frontal 0.4 cm., temporal, 0.2 cm., 0.4 cm. and occipital, 0.6 cm. Grooving for the middle meningeal arteries very narrow and shallow on the right. The dura is not adherent and in the frontal region one sees the convolutions through it. There is some thickening of the dura in the middle meningeal distribution. The longitudinal sinus free. The dura seems dense and fills the cranium cavity except in the frontal portion where there is a space between the frontal portion and the inner table sufficient to insert three fingers. The pia mater is somewhat injected over the vertex.

The brain is exceedingly compact and firm.

At the base of the brain a striking appearance is presented by the depression of the orbital portion of the frontal lobes in their central portions and the marked foreshortening or (?) absence of the prefrontal regions. The olfactory bulbs somewhat softened. The optic nerves slightly thinned but show no atrophy. The pia mater over the cerebellum is markedly thickened and opaque. The floor of the 4th ventricle is clear. Pons and medulla are firm. There is marked pressure pointing over each lobus pyriformis. The 3rd ventricle contains a quantity of clear fluid (specimen taken for gold reaction).

The superior surface of the brain is uniformly firmer than normal, there being no points of softening or change in consistency with the exception of the posterior portion of the left angular gyrus. The convolutions of the entire surface have a tendency to be less plump on the crowns than is normal; this is seen particularly on the right side.

The occipital lobes somewhat foreshortened but are flush with the cerebellum. The first temporal on the right is slightly wider than its fellow and there is a difference in the winding of the second convolution.

The Gasserian ganglia, the pituitary, the optic discs, middle ears, and cord negative on section.

The brain weight is 1450 grams.

Anatomical Diagnosis.

Poorly developed.
Pellagra.
Bruises, extremities.
Decubitus (Shoulder and trochanter major, knees.)
Saddle shaped nose.
Unequal pupils.
Sordes on lips.
Teeth poor.
Induration appendix.
Chronic fibrous pleuritis.
Acute vegetative endocarditis (aortic valve).
Pulmonary congestion; beginning bronchial pneumonia.
Acute bronchitis.
Acute splenitis.
Infarct spleen.
(?) Post mortem change adrenals.
Infarct of Kidney.

Acute parenchymatous nephritis.
Acute hepatitis.
Chronic gastritis.
Head narrow.
Scalp adherent.
Calvarium dense.
" thin.
Focal thickening of dura.
Injection pia.
Thickening of pia cerebellum.
Evidences of brain swelling.
General cerebral gliosis.
Superficial atrophy convolutions (flattening of crowns).
Inequalities first temporal convolutions.
Brain weight 1450 gms.
(Tigges' formula 1152 gms.)
Cord not remarkable.

c) Special Anatomical Description of Brain.

The brain in general suits the dolichocephalic skull. There is a slight occipital asymmetry such that the right lobe is shorter than the left, deviates somewhat more from the median line and has a groove upon the posterior extremity, whereas the left occipital lobe deviates slightly to the right and even somewhat overreaches the median sagittal plane (the posterior extremity of the left occipital lobe, however, deviates again leftwards).

The gyri of this brain are in general rather narrow, closely approximated except at the borders of the summits. The corpus callosum is of good width except for a somewhat narrow middle third. There is no evidence of the middle commissure. The cerebellum projects farther backward on the right than on the left (compare contralateral asymmetry of occipital lobes). The cerebellum suggests in general a reduction in size and the inferior surface of the cerebellum shows a considerable thickening of the pia mater, especially over the incisure. The pia mater of the brain in general is slightly thickened and hazy.

d) Microscopic Examination.

An abstract of important findings is as follows: —

Subpial gliosis is found in a number of areas, for example, focally in the precentral and postcentral angular gyrus; but in other areas the plexiform layer seems to be normal. The white matter is not, as a rule, affected by gliosis, although the angular gyrus of superior parietal area and frontal regions show a general increase.

Satellitosis is found in a number of areas (precentral, occipital, temporal angular, superior parietal, prefrontal).

The Weigert myelin sheath stains show a certain indistinctness in the supraradiary layers, precentral, postcentral, temporal, angular, superior frontal (here patchy). A good deal of this fiber change might be within the limit of artefact.

The nerve cells show numerical hypoplasia in a number of areas; the right upper precentral area, for example, shows very few cells in the supragranular region, aside from the outer small pyramids. This condition is less marked in the postcentral area where the distinction of supra and infragranular layers is more evident. The right superior temporal region shows marked cell scarcity and the arrangement of the cells is markedly irregular. The supragranular layer of the right angular gyrus is narrow and of a somewhat abnormal development. The infragranular layer here shows marked thinning out of cells. The right superior parietal area shows a more marked architectural disturbance in the infragranular region. The cells of the second supragranular layer are also much thinned.

The right superior frontal region shows marked lack of cells in the second and third layers. The prefrontal region, on the other hand, shows fairly well developed supra granular layers with a few foci here and there of thinning out. These foci affect all the layers. The infragranular layer also shows a tendency to patchy cell loss. This case being one of Pellagra shows a rather rich display of acute nerve cell changes, with excellent examples of the axonal reaction in the Betz cells. There was in one region (right, upper postcentral) a focus in which there were a few round cells in the perivascular spaces; it could not be made out that these were definitely lymphocytes and they may perhaps be regarded as neuroglia cells.

e) Anatomical and Histological Summary.

The brain of this case in an idiot or low imbecile of 2-4.5 years, Binet age, weighed 1450 grams, and may be regarded as fairly complex in construction. The grey matter, white matter and corpus callosum stand in fair proportion to one another, except that the gyri of the brain fail to approximate along the borders of their summits and that the middle third of the corpus callosum is narrow.

Subpial gliosis and satellitosis are in fairly frequent evidence, but there is little or no affection of the white matter by gliosis. The nerve cell pictures show, to qualitative judgment, frequent instances of cell scarcity affecting both the supra granular and infra granular layers.

The following is a brief characterization of each of the ten cases in the Waverley Research Series, which may be helpful for quick reference.

Case I. The brain of this microcephalic idiot, of a mental age estimated less than one year, has somewhat the suggestion of the brain of an ape. A good portion of the cerebellum is visible from the dorsal aspect of the nervous system. Whatever the cause of microcephaly, the fact that an elder sister of this patient was almost equally deficient and almost identically microcephalic, must be taken into account, as well as the fact that other children before and after the microcephalic pair seem to have been normal, or at all events not microcephalic. The mentality of this case was undoubtedly the lowest of our series.

Case II. Also microcephalic, this case presents a combination of microcephaly with a high degree of internal hydrocephalus. This hydrocephalus is one doubtless *ex vacuo*, being very possibly due to an early non-syphilitic (poliomyelitic?) infection at three months of age. The detailed description will show how well preserved was the vision of this case, functionally speaking, despite the remarkable cystic condition and microgyria of the posterior portion of the cerebrum. In point of fact, the visuo-sensory portion of the cortex appears, however, to have been preserved, and the tremendous lesion to be noted on the upper aspect of the parieto-occipital regions did not take effect upon the elementary visual functions of the cortex. The case is evidently one of focal brain lesion, and very probably belongs in what Tredgold would call the group of "secondary amentia." Of course it is possible that the microcephaly was in some sense an example of primary amentia and that the focal posteriorly lying lesions with compensatory hydrocephalus were due to intercurrent disorder. It is possible, accordingly, that this case may be one of a combination of primary and secondary amentia.

Case III. The brain of this microcephalic imbecile was so small (610 grams) that any coarse arrangement of the brains of the present series (Cases I-X) must naturally show "Zip's" brain lower than his actual capacity would have warranted. It is stated that this patient knew how to read and write a little. Although unable to support himself he had lived most of his years outside of institutions, being a harmless, amiable vagrant. With some hesitation, he may perhaps be placed among the imbeciles. Microscopic study indicates a special thinning of cells in the frontal and parietal regions as well as a degree of gliosis in the outermost layer of the cortex and below the appendema of the ventricles. The corpus callosum was well preserved and of a good size in proportion to the

brain. Microscopically the case will form an excellent foil to Case I, a case of far less intelligence, but the microscopy is complicated by gliosis, whose age is difficult to determine. (In this connection, it must be remembered that the patient is said to have had an epileptic attack at one time.) Although the brain at first sight seems a good instance of a brain in miniature, and although the frontal and temporal regions are fairly uniform, the parietal and occipital lobes are quite asymmetric, especially in that the right occipital lobe is considerably shorter than the left; there is a suggestion of an *Affenspalte* on the right side.

Case IV. This case is the oldest of the series (62 years), being an old almshouse case, apparently of feeble-mindedness, of unknown grade but apparently far higher than that of any other member of the series (except V, with the question of dementia praecox, and VIII, the executed murderer). It is of course possible that this case is an old dementia praecox (compare hallucinations observed at Danvers Hospital). The corpus callosum was rather thinner than normal; the brain weighed 1340 grams at death. Throughout the brain, in different places, there were various degrees of gliosis and satellitosis. This was especially marked in the left and right prefrontal regions. The whole brain suggested a slight degree of atrophy (slight sulcal flaring). There was a slight asymmetry, particularly of the poles of the brain; the parietal region shows a tendency to microgyria, and the right pyriform lobule is larger and more prominent than the left. There is a marked dilatation of the lateral ventricles except the descending horns. The gross appearance of the brain must be admitted to be entirely consistent with the hypothesis of dementia praecox; yet the case is a good instance of the so-called old demented imbecile found in almshouses and is of value in this series for comparison with others.

Case V. Case V falls in a group with Cases IV and VIII as of higher intelligence than any of the others in the present series (Cases I-X). It is possible that the original intelligence of Case V was higher than that in Case VIII, and highly probable that it was higher than that in Case IV. The case is interesting as showing the outcome of a truant high school boy existence. It is probable that the patient was a moron, or at all events a subnormal subject and perhaps belongs in the delinquent group. The unilateral moderate hydrocephalus is not infrequent in dementia praecox. The left frontal and right occipital lobes show contralateral asymmetry, being narrower than their fellows. The right occipital atrophy or aplasia appears to centre in the second gyrus. The corpus callosum in this case is of a good size. The brain weighed 1335 grams.

Case VI. This case is that of an idiot of two years mental age, who seemed to combine the typical features of idiocy in such a way as to be a case *par excellence* for clinical demonstration. The brain, weighing 1130 grams, shows the smallest brain weight of our series outside the group of pronounced microcephalic cases. The brain is of very simple construc-

tion. The histological examination showed in this case, as in Case VII, the occurrence of the so-called "rod cells" in the cortex. These cells, characteristic of general paresis when associated with the exudative and destructive changes found therein, are not to be interpreted as necessarily indicating syphilis when they occur alone. Perhaps they indicate merely proliferating vascular changes or proliferations of unknown nature of mesenchymal tissue. There is, however, a suspicion of syphilis in the antecedents of this almshouse transfer case, and certain "tissue paper" scars found on the skin at autopsy may add to the suspicion that this may be a case of congenital syphilis of a non-exudative type. It is also possible that good fortune, or a still more minute microscopic examination than we have been able to perform, would reveal exudative changes at some point. Another feature of the greatest interest in Case VI is the virtual absence of one vocal cord as demonstrated at the autopsy. This fact may serve to illustrate the difficulties of proper interpretation in routine cases. In this case, for instance, the aphasia could not be taken to be necessarily of nervous origin.

Case VII. Like the brain of Case VI, the brain of Case VII showed rod cells. With respect to the possibilities of syphilis in the family, it is important to consider that of five children, three of the children were dead (two of marasmus), and that the mother was subject to fainting fits. A great variety of anomalies in the body is probably entirely consistent with the hypothesis of syphilis. There was a certain irregularity in the mental capacities of the case, which should also be regarded as thoroughly consistent with this hypothesis. Thus the case, classified as an imbecile with a mental age of five, seemed in a number of respects not to reach above the highest grade of idiocy, or a lower grade of imbecility than the mental age would superficially indicate. There was some sensory disorder in the case as well. Accordingly, both VI and VII are cases which bring up the question of congenital syphilis of a character not so destructive or progressive as cases of exudative syphilis (of the group, for example, of juvenile paresis) would be. To be sure, the rod cells indicate a certain activity and progressiveness on the part of the disease. Theoretically and academically, at any rate, these cells may indicate that conditions are not so entirely stationary in the nervous system as we are led theoretically to suppose should be the case in the brains of the feeble-minded.

Case VIII. This belongs with Cases IV and V, amongst those of highest intelligence in the present series (Cases I-X). The case was that of an executed murderer. The brain was viewed on anatomical grounds to be that of a defective before there was any clinical confirmation or knowledge of the fact. The gyri were noted to be of a generally transverse direction. There was a lack of complete longitudinal sulci in the frontal lobes. A blunting of the frontal lobes was possibly the most convincing suggestion of the probable

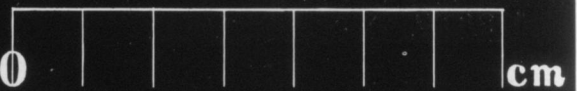
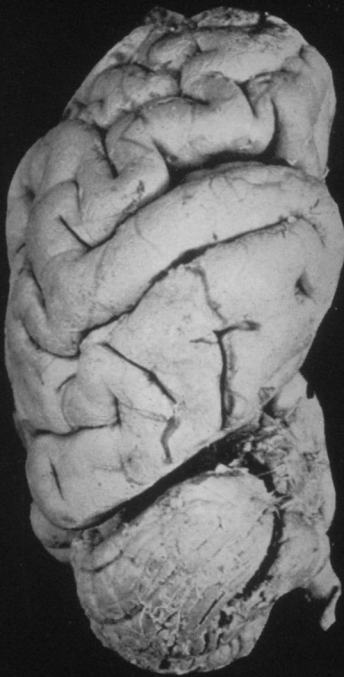
clinical deficiency on the part of the subject. The parietal region was relatively and absolutely well developed. There was an asymmetry of the pyriform lobules, to some extent of the entire hippocampal lobule. The corpus callosum was of good size though there was a question whether it might not be regarded as somewhat thinned out posteriorly. It seems safe to regard this case as either in the moron group or as at any rate to some degree subnormal.

Case IX. Case IX illustrates the "ablebodied" type of imbecile (mental age, 7). The weight of the brain in this case was even in excess of what it should have been by Tigges' formula; namely: 1622 grams, as against 1424 by Tigges' formula. (It is true that the violent death of this patient may have led to a certain congestion of the brain which artificially increased its weight.) The brain of Case IX, quantitatively adequate as it would seem, was a brain which must strike the anatomist as of exceedingly poor mould.

Case X. The brain weight in Case X was also high, being 1450 grams, and in point of fact 298 grams in excess if we should trust Tigges' formula. He is described as of a very excitable nature. The brain shows a very considerable degree of hydrocephalus. Attention may be called to some theoretical points concerning hydrocephalus in these cases in a special section devoted to this topic. Case X, like Case VII, was of the excitable group, and the brain of Case VII also showed hydrocephalus, which likewise does not seem to be explicable on the basis of a compensatory condition (*ex vacuo*, as illustrated by Case IV), or an anomaly of the dementia praecox group (as illustrated by Case V).

I-a

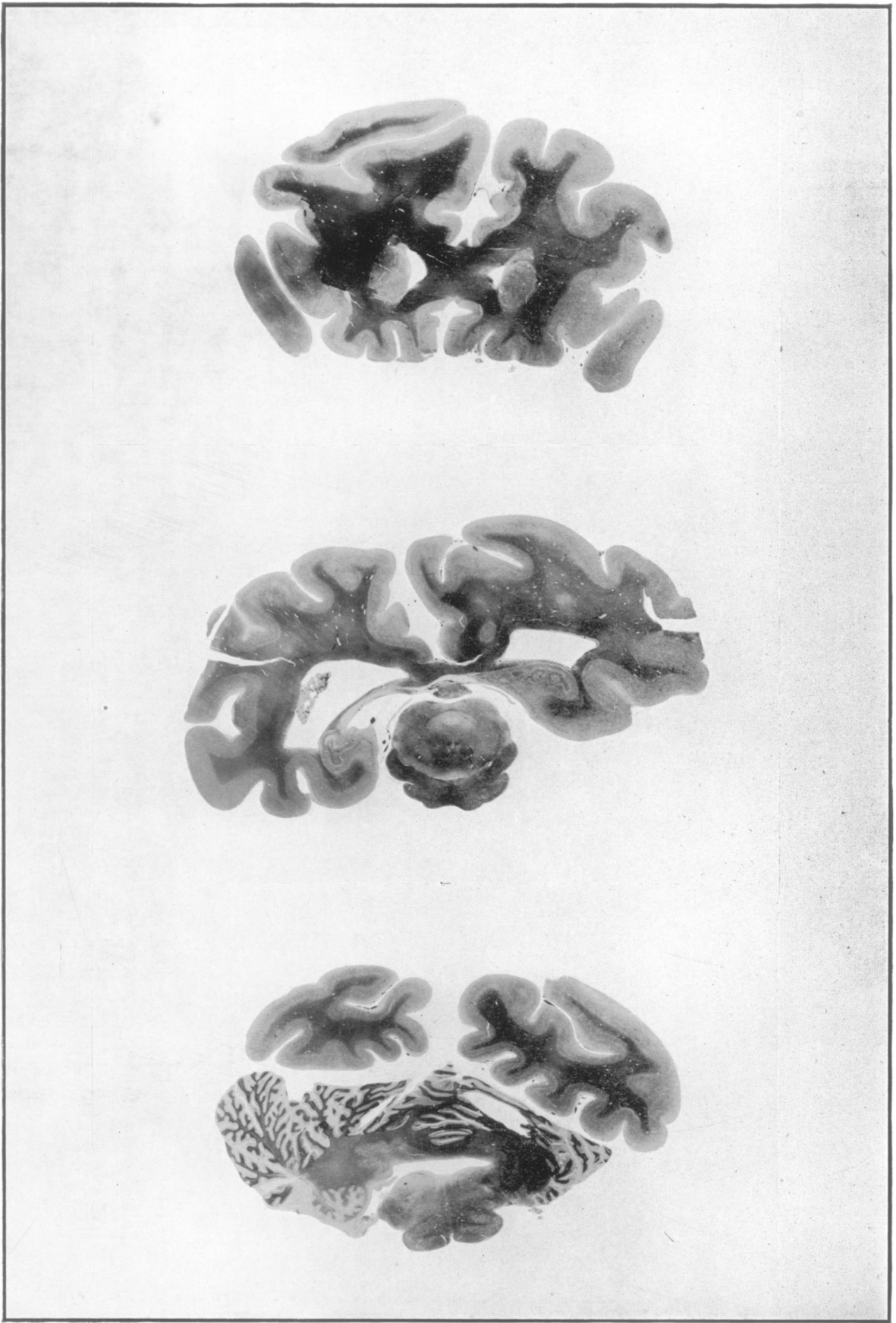
I-b



I-c

I-d

CASE I — MICROCEPHALY. LOW IDIOT

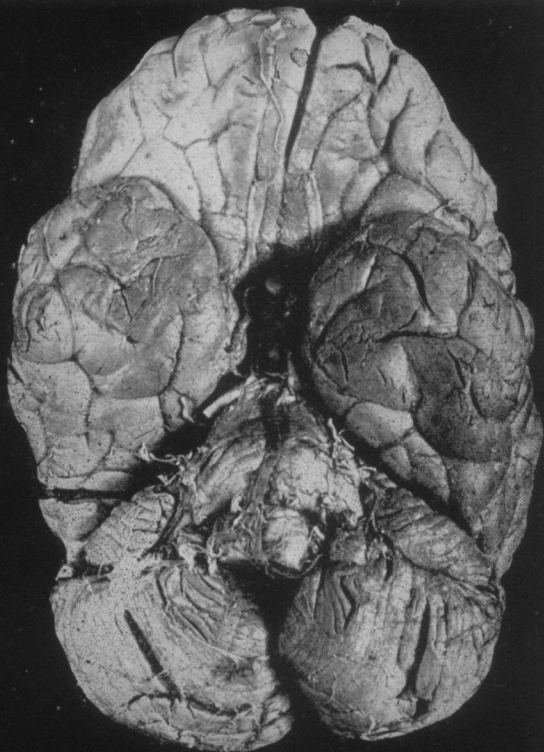
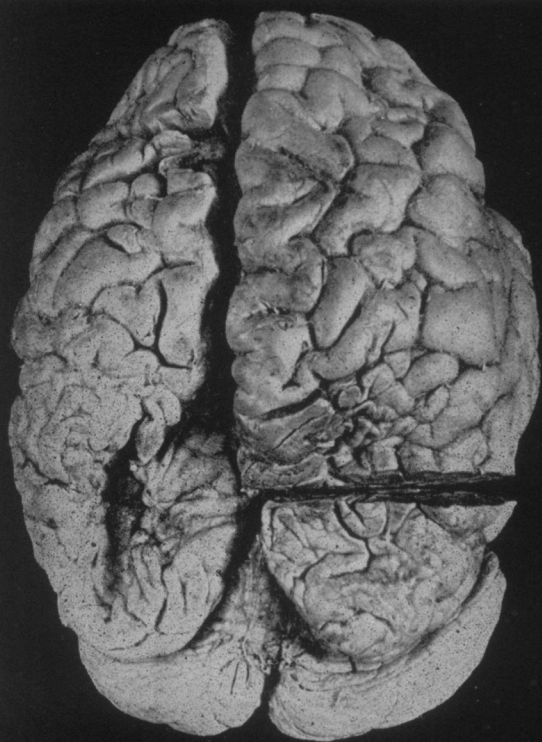


I-e, I-f, I-g

CASE I — MICROCEPHALY. LOW IDIOT

II-a

II-b

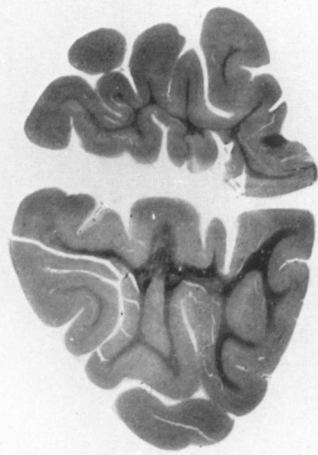


II-c

II-d

CASE II — MICROCEPHALY, ENCEPHALITIC. LOW IDIOT

II-e



II-f



II-g



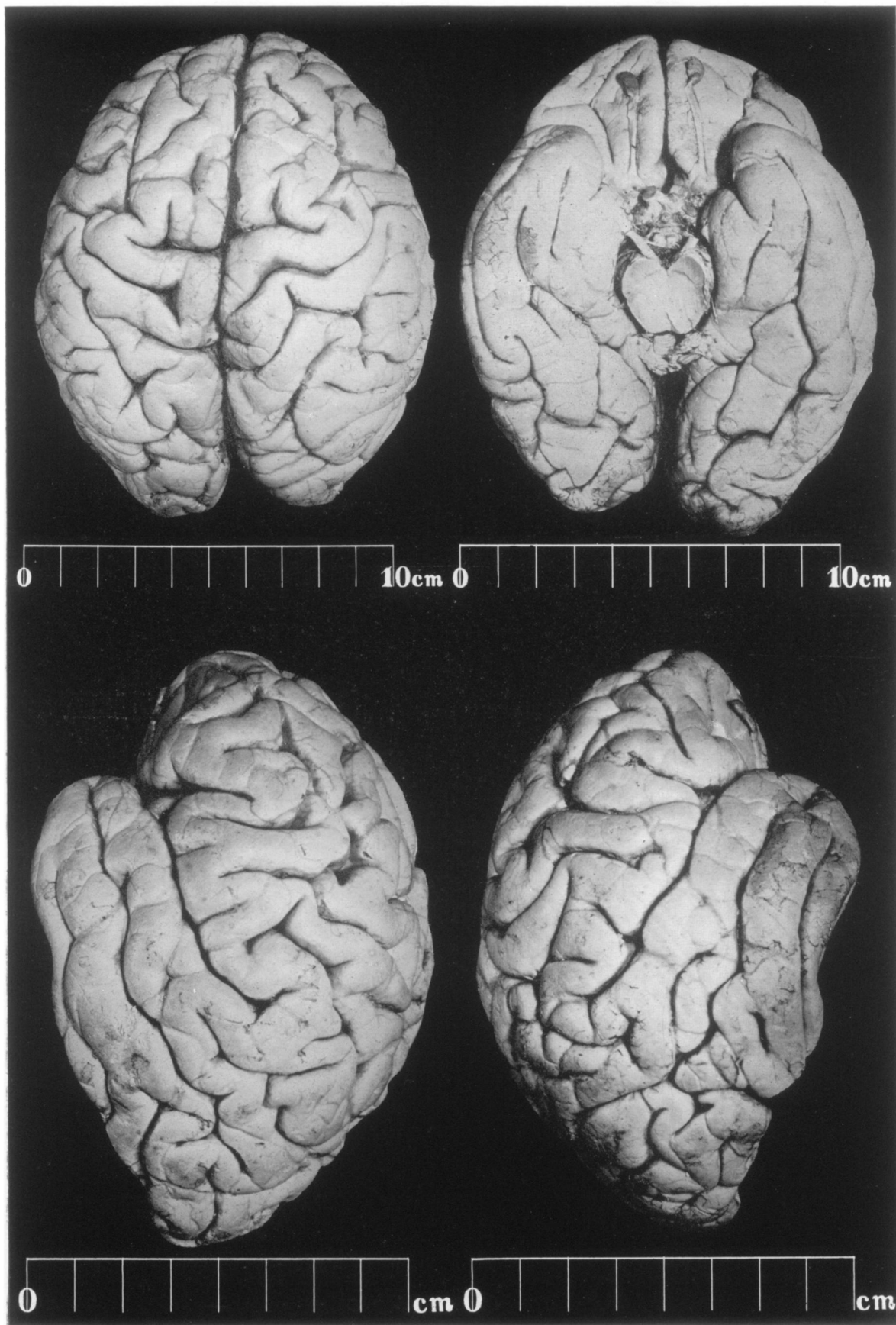
II-h



CASE II --- MICROCEPHALY, ENCEPHALITIC. LOW IDIOT

III-a

III-b



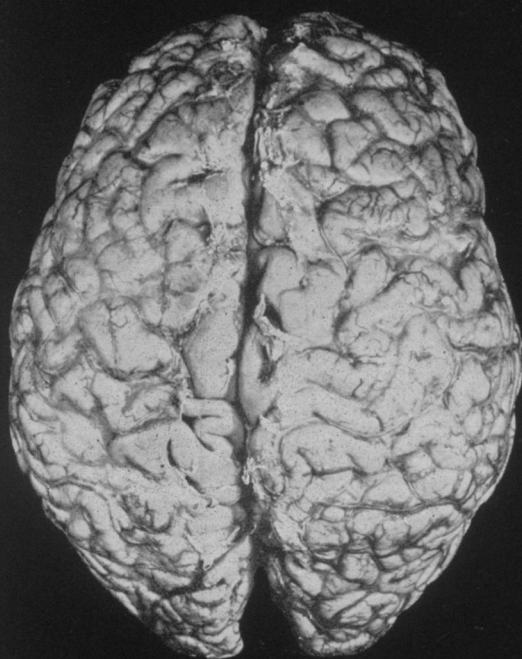
III-c

III-d

CASE III — MICROCEPHALY. IMBECILE "LITTLE ZIP"

IV-a

IV-b



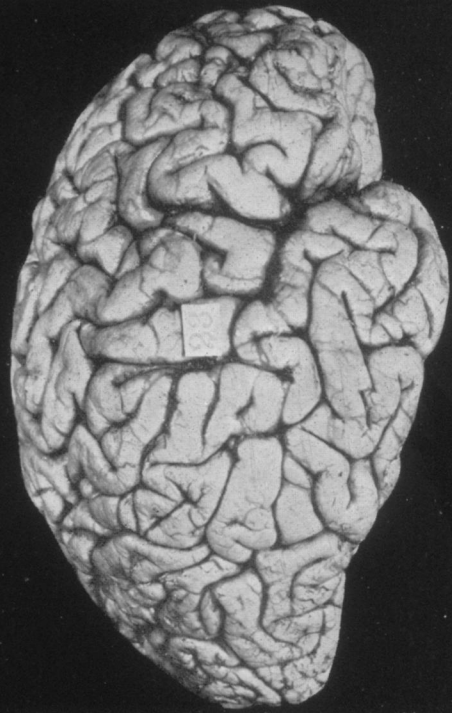
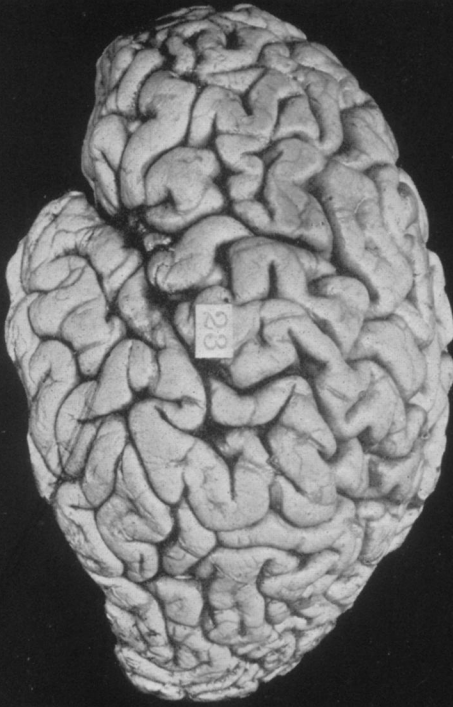
IV-c

IV-d

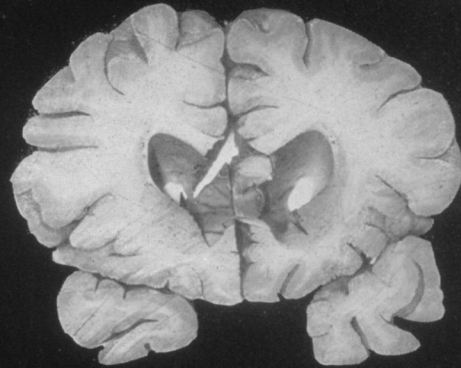
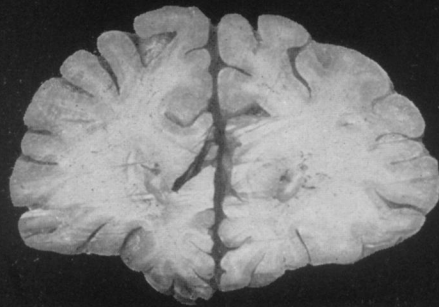
CASE IV — OLD ALMSHOUSE MORON

IV-e

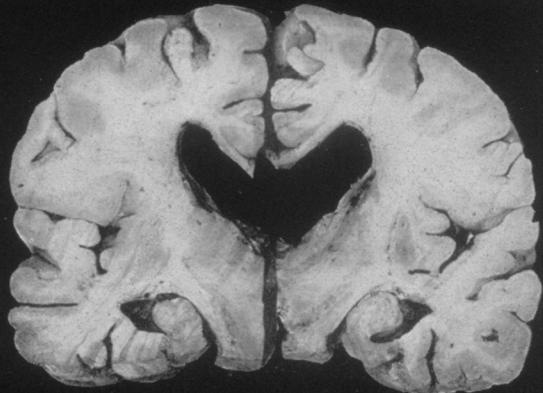
IV-f



IV-g



IV-h



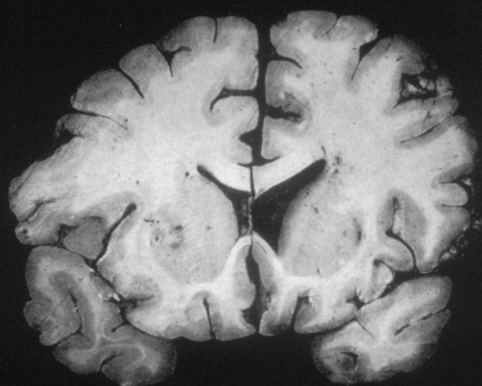
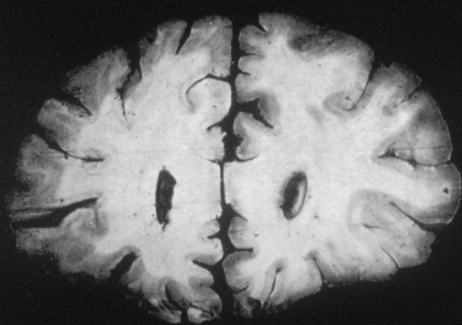
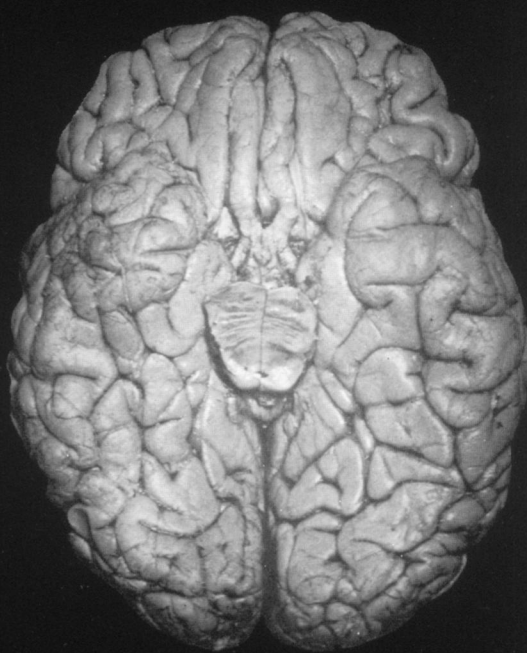
IV-i

IV-j

CASE IV — ALMSHOUSE MORON. NOTE HYDROCEPHALUS

V-a

V-b



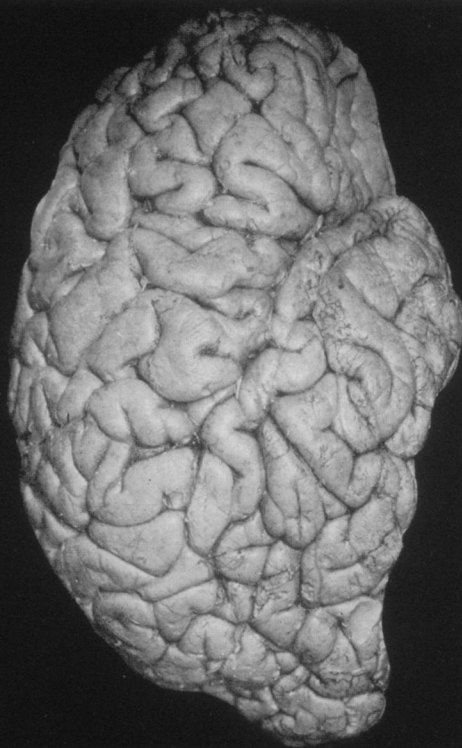
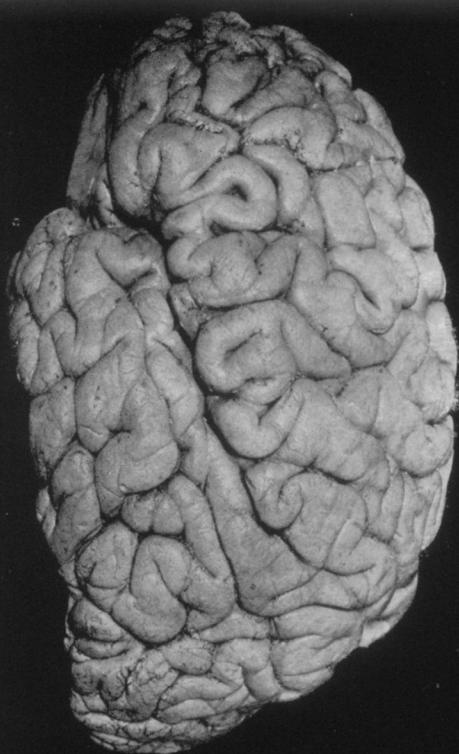
V-c

V-d

CASE V — MORON, TRUANT, DEMENTIA PRAECOX (?)

V-e

V-f



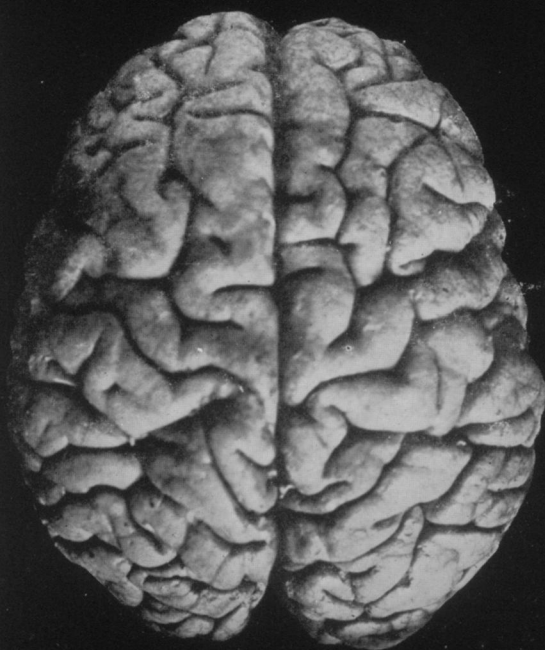
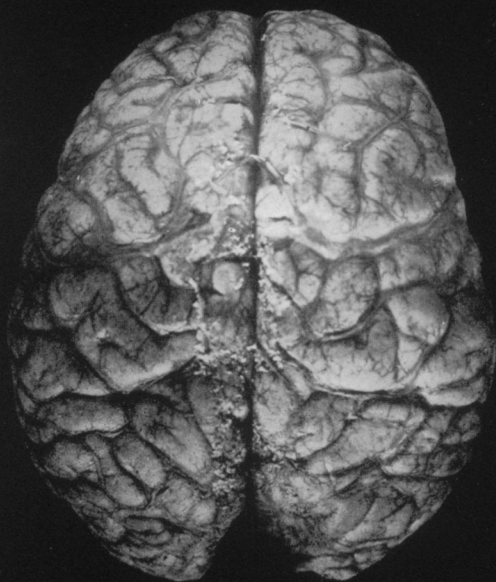
V-g

V-h

CASE V -- MORON, TRUANT, DEMENTIA PRAECOX (?)

VI-a

VI-b



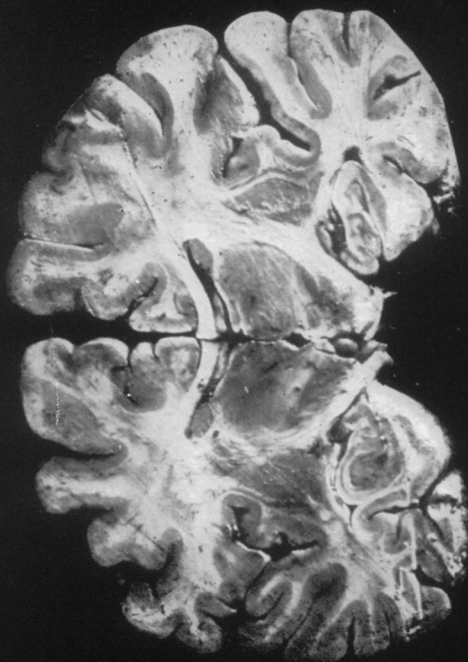
VI-c

VI-d

CASE VI — IDIOT (APHASIA, VOCAL CORD ABSENT). SYPHILITIC (?)

VI-e

VI-f



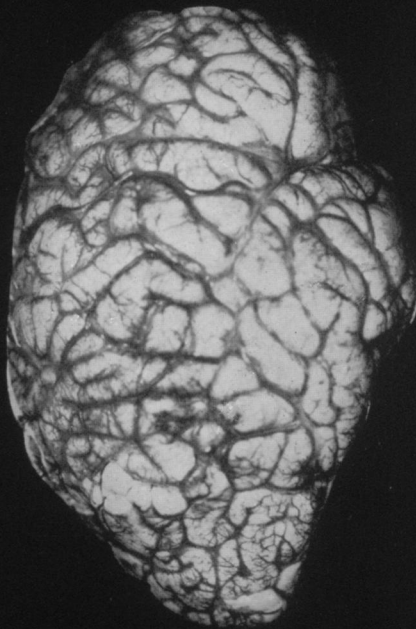
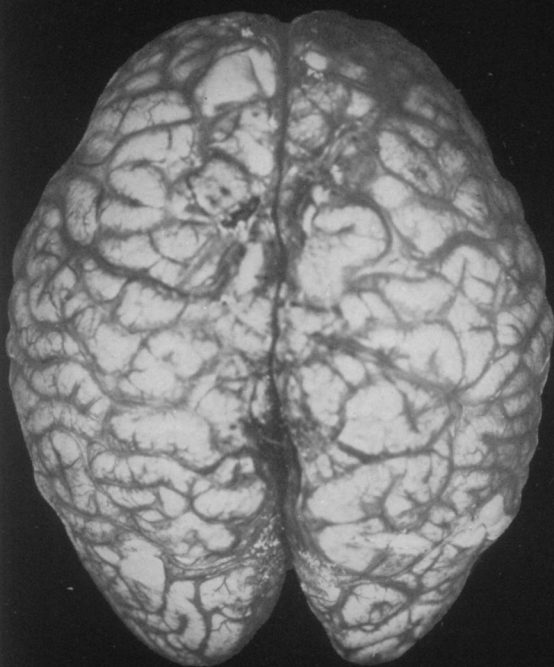
VI-g

VI-h

CASE VI — IDIOT. SYPHILITIC(?) CORPUS CALLOSUM THIN

VII-a

VII-b



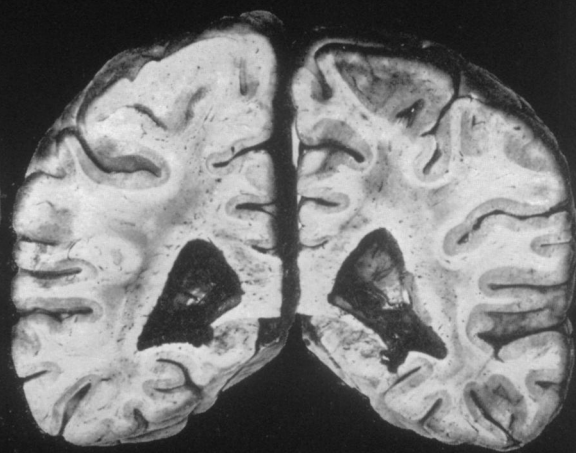
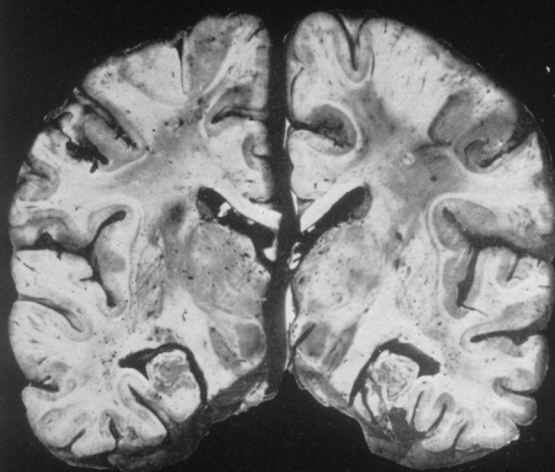
VII-c

VII-d

CASE VII — IMBECILE. SYPHILITIC (??)

VII-e

VII-f



VII-g

VII-h

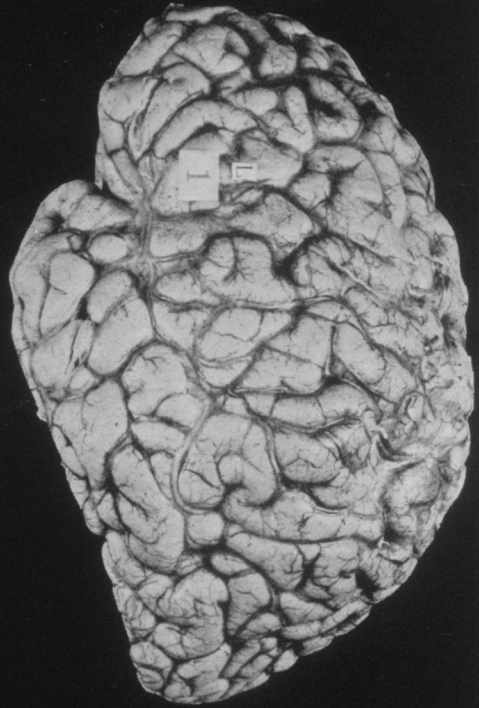
CASE VII — IMBECILE, SYPHILITIC (?)

VIII-a

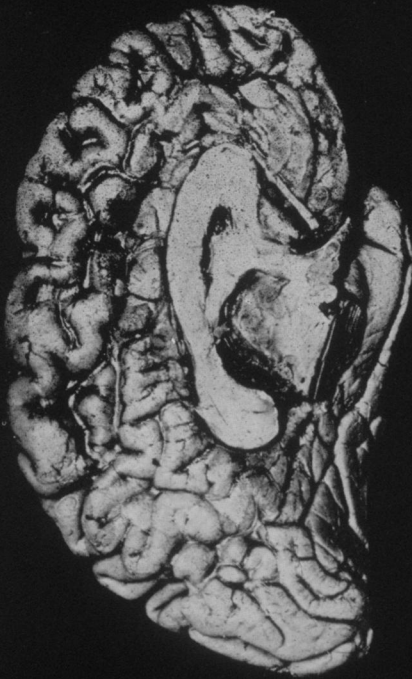


0 10cm

VIII-b



0 10cm



0 10cm



0 10cm

VIII-c

VIII-d

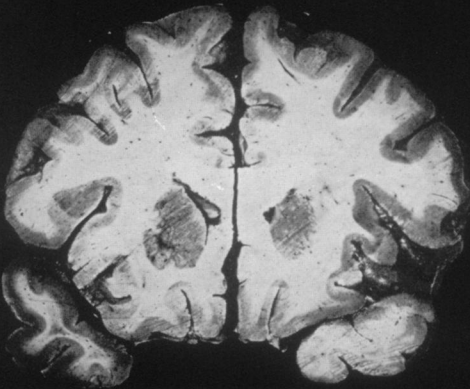
CASE VIII — MORON OR SUBNORMAL. EXECUTED MURDERER

VIII-e



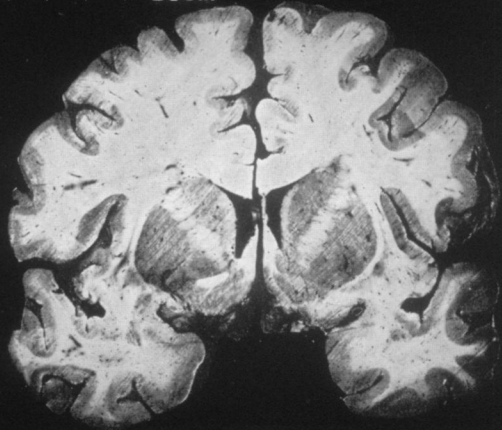
0 10cm

VIII-f

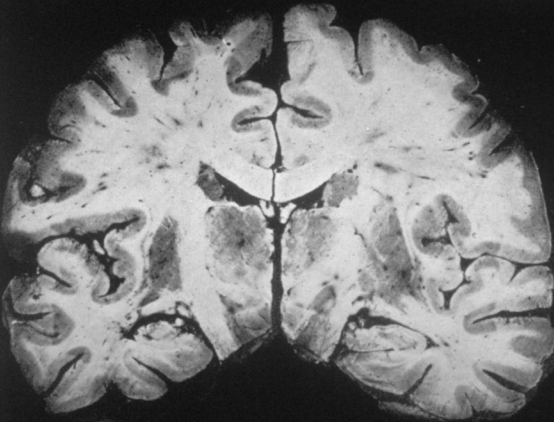


0 10cm

VIII-g

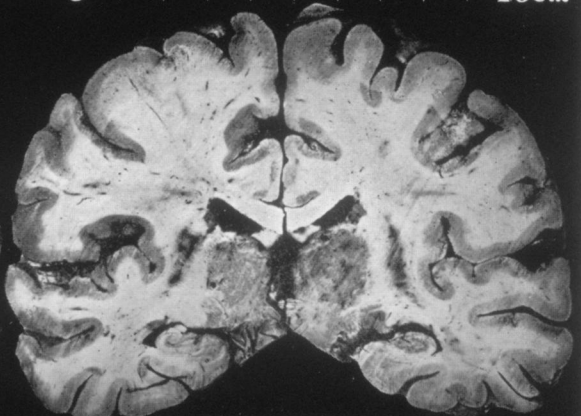


0 10cm



0 10cm

VIII-h



0 10cm

VIII-i

CASE VIII — MORON OR SUBNORMAL. EXECUTED MURDERER

IX-a

IX-b



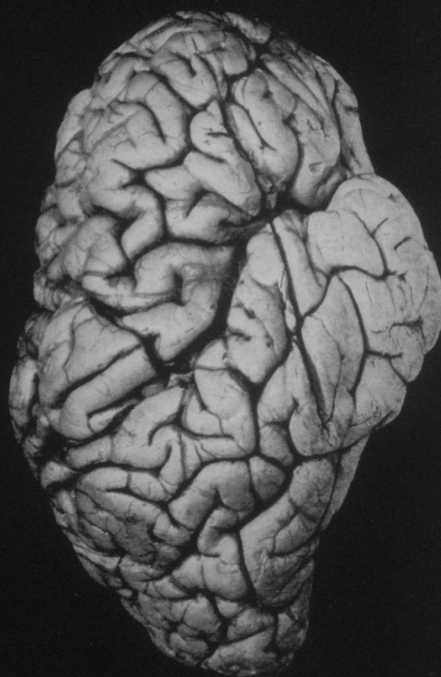
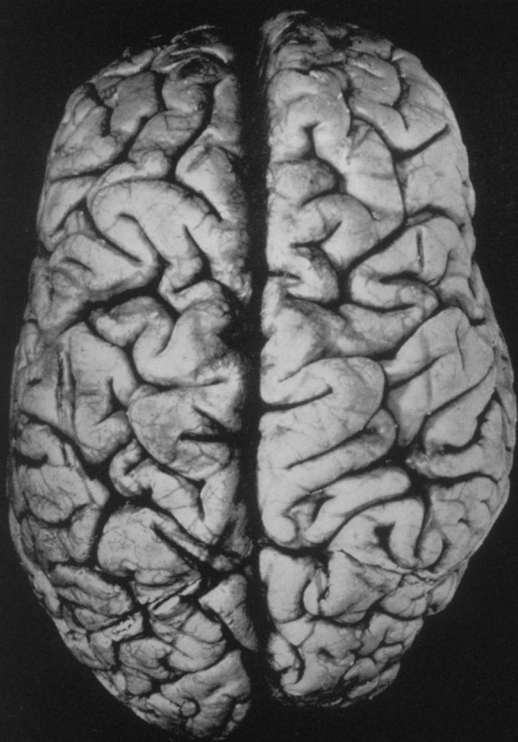
IX-c

IX-d

CASE IX — "ABLE BODIED" IMBECILE. BRAIN WEIGHT 1622 GRAMS

IX-e

IX-f



IX-g

IX-h

CASE IX — "ABLE BODIED" IMBECILE. BRAIN WEIGHT 1622 GRAMS

IX-i

IX-j

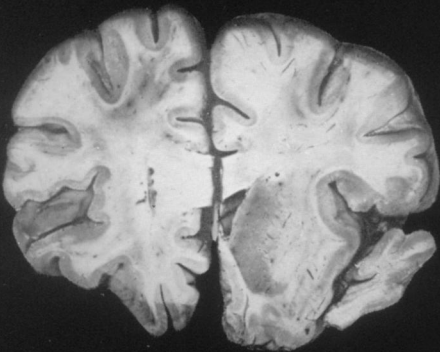


0 10cm



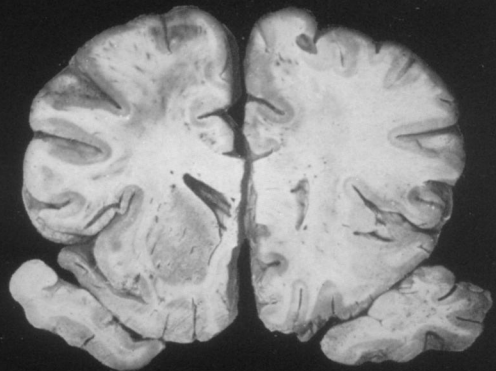
0 10cm

IX-k

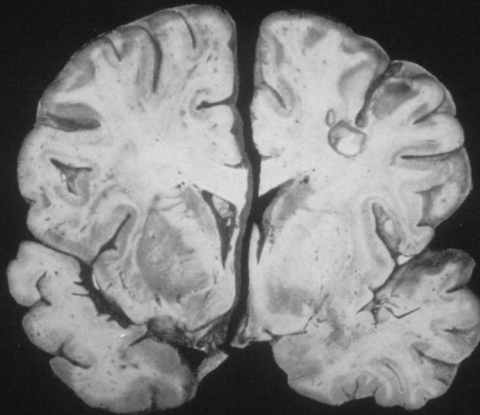


0 10cm

IX-l



0 10cm

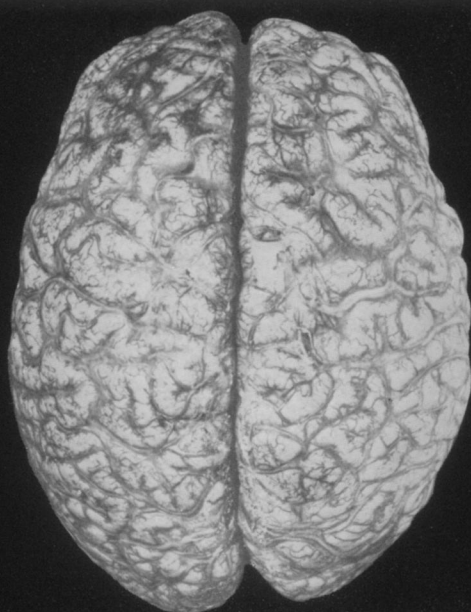


0 10cm

IX-m

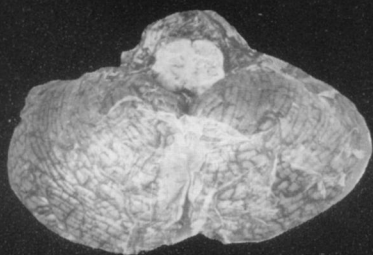
CASE IX — "ABLE BODIED" IMBECILE. BRAIN WEIGHT 1622 GRAMS

X-a



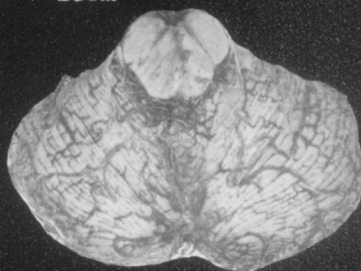
0 10cm

X-b

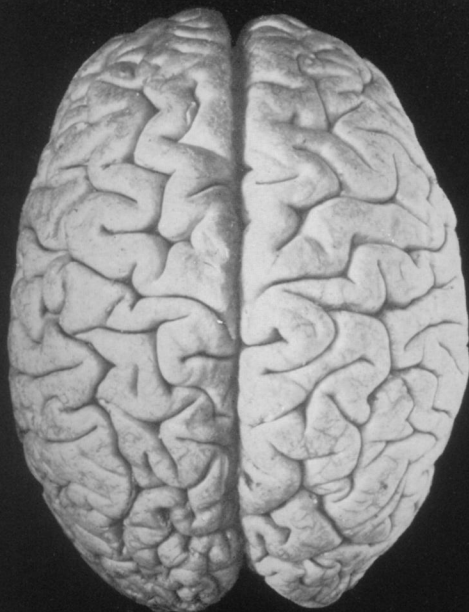


0 10cm

X-c



0 10cm



0 10cm



0 10cm

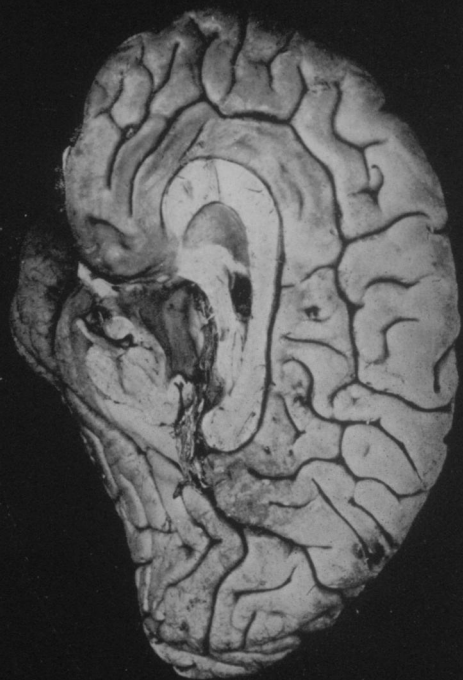
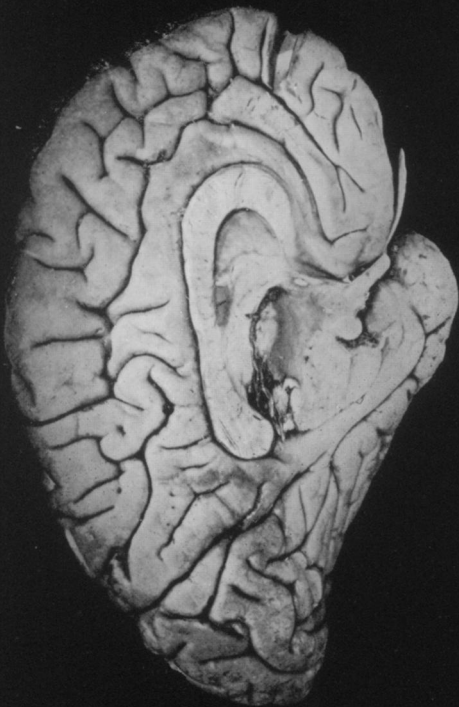
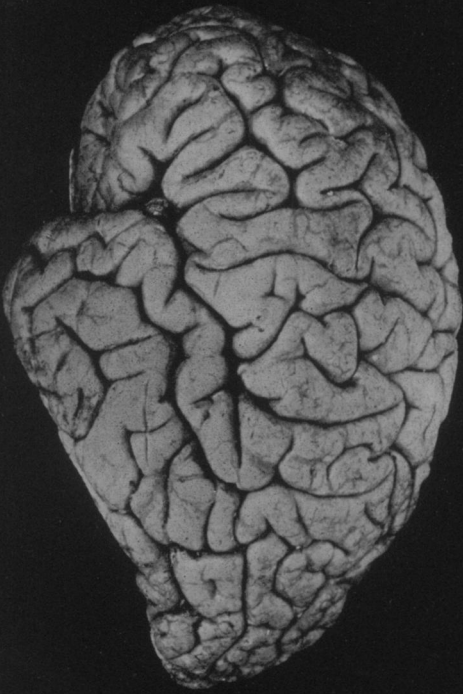
X-d

X-e

CASE X — LOW IMBECILE (BINET 2.4)

X-f

X-g



X-h

X-i

CASE X — LOW IMBECILE (BINET 2.4)